ELECTRICAL CONSTRUCTION AND MAINTENANCE

JULY • 1950

49th Year

***HOW TO** appraise electrical modernization opportunities in your area.*

***HOW TO** plan electrical modernization projects for efficient operation.*

***PRACTICAL** methods for wiring in existing commercial and industrial buildings.*

***ESTIMATING** considerations and labor data for electrical modernization work.*

ELECTRICAL MODERNIZATION

AN EDITORIAL FEATURE SECTION COMPLETE IN THIS ISSUE

A McGRAW-HILL PUBLICATION

here are 6 new G-E BALLASTS you should know about

Full information on recent G-E ballast developments is available through your nearest General Electric Apparatus Sales Office—or, if more convenient, write direct to Ballast Sales Division, General Electric Company, Fort Wayne, Ind., and your request will receive prompt attention.

Apparatus Department, General Electric Co., Schenectady 5, New York.

This label on a fixture carton, or the familiar G-E ballast tag on a fixture, is your assurance of fine ballast performance. Buy—when you see the G-E ballast label or tag.

NEW! TRIGGER START BALLASTS for instant starting operation of 32-watt circline and 20-watt standard lamps. Eliminate starters completely. A natural sales booster for residential-type fixtures.

NEW! LOWER-PRICED, QUIETER single-lamp ballasts (either uncorrected, or high-power factor) for 30- and 40-watt lamps. New electrical design means more efficient operation than ever before. New type construction has made possible extremely low noise levels.

NEW! SMALL CROSS-SECTION TU-LAMP ballast for 40-watt lamps. Designed to give quiet operation in small-channel fixtures. Only 2⅛ inches wide and 1⅜ inches high! Maximum performance from this narrow cross-section ballast.

NEW! FOUR-LAMP SEQUENCE START ballast for 85-watt standard lamps. Provides high operational efficiency with low installation costs. The most economical lighting for many applications—industrials in particular.

NEW! SMALLER, LOW-LOSS SERIES BALLASTS for 96T12, 72T12, 48T12, and other instant-starting 40-watt ratings. Lamps operated in series. Cost is lower, efficiency higher. Deliver more dollars of light per dollar of ballast.

NEW! BALLASTS FOR OUTDOOR SIGNS and other outdoor fluorescent fixtures. Special leads and capacitors permit operation at temperatures as low as −20° F. UL listed. Available in standard Slimline and Instant-starting 40-watt ratings.

GENERAL ELECTRIC

412-87

Murray
MODERN
METHODS mean Highest Quality . . . Latest Design . . . Greatest Value!

Breaking All Records!

SALES CHART

Listed by Underwriters Laboratories, Inc.

THE Murray 8 CIRCUIT

Combination Main Service and Range Switch

with

Extra Tap Connection for Hot Water Heater

Eight branch circuits, three-wire range connections, and an extra hot water heater tap are provided in this new Murray Main Service & Range Switch. Two styles for 60 amp. 125-250 volt 3 pole service — 100 amp. service lugs. Plenty of hand room for wiring all 8 circuits and range! For surface or flush mounting. Cat. No. 74-8 (Series); Cat. No. 77-8 (Parallel).

Now you can equip today for tomorrow's bigger loads! The NEW Murray 8 Circuit Combination Main Service and Range Switch, for 125-250 volt service, provides for *eight* branch circuits, plus three-wire separately fused range connections. In addition, an extra tap simplifies hot water heater wiring . . . makes adding a heater later even simpler!

Yes, you can equip today for the loads of tomorrow — with the new Murray 8 circuit main service and range switch. For full details, contact your Murray representative, or write

Murray

MANUFACTURING CORPORATION

50 Years of Service to the Electrical Industry

1250 ATLANTIC AVENUE • BROOKLYN 16, NEW YORK

FOR TOMORROW'S LOADS . . .

Equip Today!

SERVICE ENTRANCE & METER EQUIPMENT • MAGNETIC CIRCUIT BREAKERS
SWITCHES • CURRENT LIMITING REACTORS • CROWS NEST AERIAL LADDERS

SPORTO—With or without glass cover. Weather-proof hood permits complete vertical or lateral positioning.

LUMO—Made from aluminum, Alzac finished, chemically processed. With or without heat resisting glass lens; narrow or medium beam spread.

DIFFUSO—For even illumination of service stations, athletic fields, tennis courts, parking areas, etc.

ACTION AFTER DARK

APPLETON LIGHTING EQUIPMENT

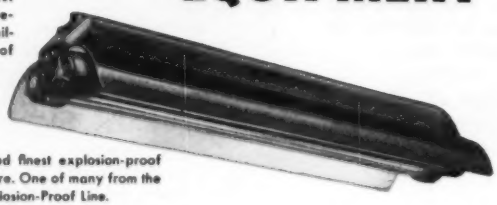
Night game attendance soars upward every year. Thanks to modern floodlighting, millions more now see their favorite athletes in action.

Expertly engineered Appleton Lighting Equipment provides day-like illumination for night recreation centers, as well as the hundreds of industries maintaining round-the-clock production schedules.

Indoor or outdoor lighting planned with Appleton Fixtures assures top-notch lighting efficiency at minimum installation, service and operating expense.

Appleton Lighting Fixtures are available in the exact type and size for every industrial requirement—including hazardous locations. Appleton's skilled illuminating engineers are ready to help solve specific lighting problems. For the finest in lighting—specify Appleton—pace-setting manufacturer of electrical equipment for nearly half a century.

DISKONECT—The most practical detachable reflector ever made. Available in a wide variety of reflector styles.



TYPE EFU—The first and finest explosion-proof fluorescent lighting fixture. One of many from the complete Appleton Explosion-Proof Line.

SOLD THROUGH ELECTRICAL WHOLESALERS

APPLETON ELECTRIC COMPANY

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Branch Offices: NEW YORK, 50 Church Street • DETROIT, 3049 E. Grand Blvd. • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street ST. LOUIS, 227 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA, 724 Boulevard, N. E. • BIRMINGHAM, 429 Brown-Marx Bldg. MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. • BALTIMORE, 100 East Pleasant Street • BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry Street • CINCINNATI, 626 Broadway • HOUSTON, 738 M. & M. Bldg. • HAVANA, Cuba, Malecon No. 9

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Export Representatives: International Standard Electric Corp., 67 Broad St., New York 4, N. Y.

APPLETON

CONDUIT FITTINGS • LIGHTING EQUIPMENT • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

49th Year — JULY • 1950

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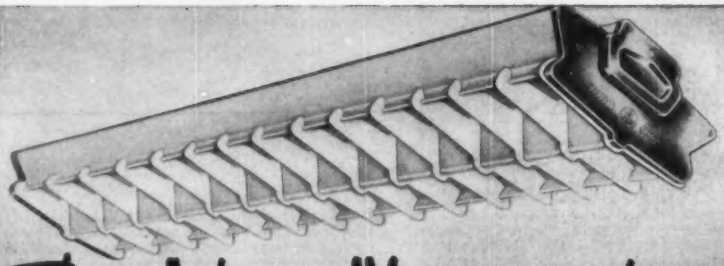


The New "Lenox Look"

FOR STORE LIGHTING

NOW! LUMINOUS PLASTIC SIDES!

Good looking? You've never seen such style and beauty in a fluorescent store lighting fixture before! The smartly designed "Lenox" series, now available with extruded plastic side panels, retains all its high efficiency and low brightness ratios—and adds soft, diffused side lighting to enhance its elegant appearance. The "Lenox"—for two or four 40-watt lamps—surface or suspension mounting—continuous or unit installations.

ACCENT UNITS

Adjustable or fixed accent units available for inclusion in "Lenox" runs or at the ends of runs.

and the Usual Day-Brite Premium Quality

...WITHOUT PREMIUM COST!

The "Lenox," like all Day-Brite fixtures, gives you *extra value*—example: interlocked louvers for extreme strength and rigidity; example: NO-BLINK type starters; example: HOT-BONDED SUPER WHITE enamel finish.

These and the many other famous Day-Brite top-quality features are standard equipment—*at standard prices*. Dollar for dollar, you can't equal Day-Brite's long-term, trouble-free performance at the lowest possible installation, maintenance and operating cost.

Write today for the complete "Lenox" story. Address: Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

036

"DECIDEDLY BETTER"

DAY-BRITE

Lighting Fixtures

DISTRIBUTED NATIONALLY BY LEADING ELECTRICAL WHOLESALERS

JUST SITS- AND SAVES $2630.00 A YEAR

Pickering Lumber Corp., of Standard, California, writes about G-E CAPACITORS:

"We installed a 420-kvar bank of G-E Pyranol capacitors in 1939, at a cost of $4400. They raised our power factor from 72 to 96 per cent and enabled us to avoid the penalty clause for operating below 80 per cent. In fact, we became eligible for a bonus. We find this installation has made an average *annual* saving in our power bill of $2630 43. Since 1939, this has amounted to $28,930!"

AND EVEN THAT IS NOT THE WHOLE STORY. In 1939, Pickering's connected load was 3400 horsepower—and the power system was fully loaded. Yet by installing an additional 400 kvar of capacitors in 1946, they were able to *add* 2100 horsepower of connected load.

AN EXCEPTIONAL CASE? Probably—but almost every capacitor installation *seems* exceptional. Check the savings you can make! Write for GEA-5167, "A Way to Cut Power Cost That's Too Good to Miss." Address Apparatus Department, General Electric Co., Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

407-194

Macy's

San Francisco

gets

extreme flexibility

to handle load changes and future load growth

low installation cost

everything was shipped complete—as a unit—and easily installed

safety to personnel

no exposed circuits; metal encloses all current-carrying parts

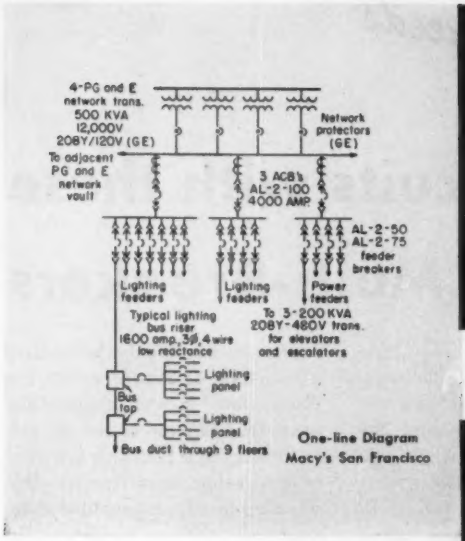
plenty of "IC"....with

100,000 amperes interrupting capacity, adequate to handle all short circuits

GENERAL ELECTRIC

HERE'S WHY . . . *"In the department store business we cannot take any chances with power outages or potential fire hazards. We must also plan for expansion. That's why we wanted our power distribution system to be safe, to have adequate feeder and branch-circuit capacity, plus flexibility. General Electric switchgear gave us all these requirements."*

E. L. MOLLOY, VICE PRESIDENT
MACY'S, SAN FRANCISCO


4-PG and E network trans. 500 KVA 12,000V 208Y/120V (GE)
Network protectors (GE)
To adjacent PG and E network vault
3 AC8's AL-2-100 4000 AMP
AL-2-50 AL-2-75 feeder breakers
Lighting feeders
Lighting feeders
Power feeders
Typical lighting bus riser 1600 amp, 3ϕ, 4 wire low reactance
To 3-200 KVA 208Y-480V trans. for elevators and escalators
Lighting panel
Bus tap
Lighting panel
Bus duct through 9 floors

One-line Diagram
Macy's San Francisco

This, the largest switchgear installation to date in any San Francisco commercial building, adequately handles the power requirements that average four watts per square foot (nearly 500,000 square feet). Flexibility of the feeder system permits load changes without increasing the load on the switchgear. The 4000-ampere breakers have induction relay tripping.

Macy's installation is a complete General Electric project—switchgear, three 200-kva transformers for elevators and escalators, power and lighting panels, motors, and control for ventilating and boiler-room auxiliaries. One source of responsibility plus the very best in co-ordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer. William D. Day, San Francisco, architect; Clyde E. Bentley, San Francisco, consulting engineer.

G-E metal-enclosed switchgear handles the incoming 120/208-volt power. The equipment is divided into three sections, two for lighting, one for power. Breakers (cascaded) are of the drawout type for ease of inspection and maintenance.

Four G-E network units, rated 500 kva, 12,000-120/208 volts in a Pacific Gas and Electric Company vault serve the building. Macy's 2500-kva load represents one of the largest loads added to PG&E's downtown network in recent years.

low-voltage SWITCHGEAR

Modern industrial power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want proper voltage for top performance of equipment, an extremely flexible setup to take care of expanding or changing loads, adequate short circuit protection, safety to personnel, and low installation and maintenance costs.

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

Investigate today the many advantages of using General Electric switchgear in your plant for efficient, flexible power distribution. Contact your G-E sales representative for further information—and write for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GEA-4966 Low-voltage Switchgear
GEA-3642 Air Circuit Breakers
GEA-2017 Network Protectors
GEA-3083 Metal-clad Switchgear
GEA-3592 Load-center Substations
GEA-3758 Load-center Distribution

GENERAL ELECTRIC

860-39

Meet domestic protection needs

Up to 20 circuits with these 6 Cutler-Hammer Multi-Breakers

SINGLE POLE
The Multi-Breaker for minimum needs. Ask for MO1

TWO POLES
The Multi-Breaker for small homes. Ask for MO2

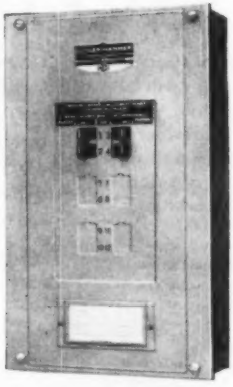
The Cutler-Hammer *simplified* line of Multi-Breakers meets all domestic protection needs—*six items providing from one to 20 circuits!* The fundamental unit is the single pole Breaker. How it combines in multiples up to 20 circuits for small, medium and large homes is shown in the adjoining pictures. Carry a relatively small stock . . . make up the item at the time . . . on the job . . . for the job.

And these Multi-Breakers offer you and the customer every desirable feature—the circuit interrupter that needs only the touch of a little lever to restore service, the "slow—fast" *thermal magnetic* element that is slow to act on safe overloads but is lightning fast even on low value short circuits (this standard feature is provided at no extra cost), the safe, factory-sealed "works" and handsome appearance which together permit the Multi-Breaker to be installed where it is most convenient. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

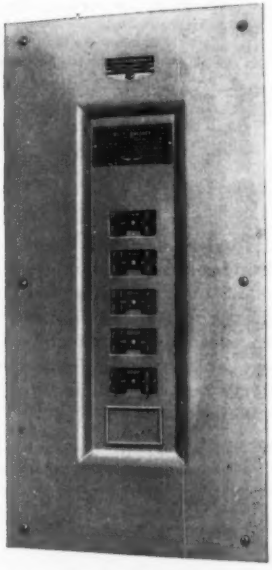
FOUR POLES
In a single block. One and two pole combinations. Ask for MO4

CUTLER-HAMMER
MULTI-BREAKER
C-H

4 POLES BASIC
5-6-7-8 POLES
made by adding single pole units. Ask for MO8

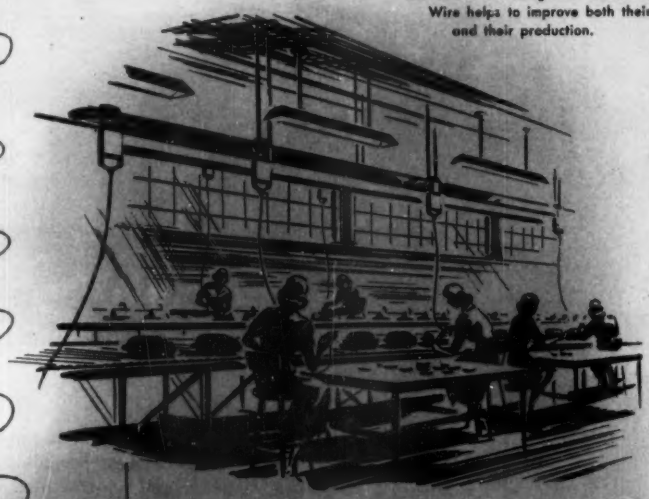


4 POLES BASIC
UP TO 12 POLES
formed by adding four-pole "plug-in" units. Ask for MO12



4 POLES BASIC
UP TO 20 POLES
formed by adding four-pole "plug-in" units. Ask for MO20

A rapidly increasing number of electrical manufacturers are finding that ROEVAR Magnet Wire helps to improve both their product and their production.



Insulation that's 10 to 40 times tougher...that's why

Today it's Roebling!

PUT ROEVAR MAGNET WIRE to the test and you'll find it's 10 to 40 times more resistant to abrasion than regular enamel insulation. And outstanding toughness like that speaks for itself . . . ROEVAR is obviously today's best choice for high speed winding.

But besides that, ROEVAR Magnet Wire insulation stretches and bends to an exceptional degree. It has high resistance to baking temperatures and to the solvents in coil-treating varnishes . . . the stamina for thoroughly dependable service.

ROEVAR Magnet Wire has a better space factor than magnet wire with fibrous insulation. *It costs less, too!* Comes in sizes No. 14 and 40 A.W.G. Try ROEVAR . . . write for full data and samples. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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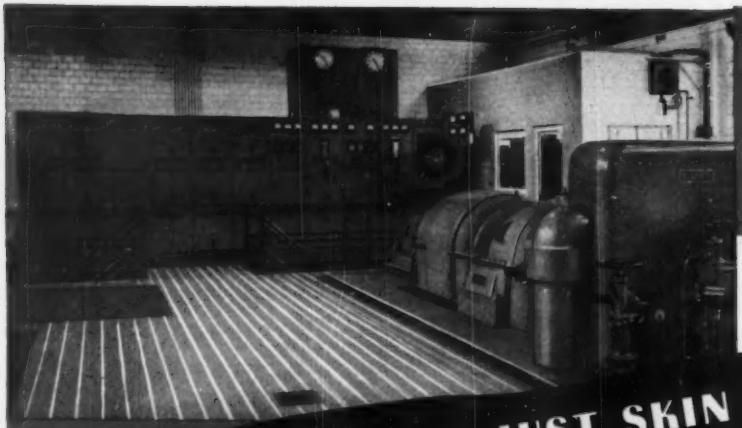


Photograph — courtesy Falls City Brewing Co., Louisville, Ky.

BEAUTY ISN'T JUST SKIN DEEP!

The attractive appearance of I-T-E Switchgear is important in itself, but only *incidental* to the operating dependability, safety and durability inherent in the design and construction.

THESE "INSIDE" FEATURES	ADD UP TO THESE BENEFITS TO YOU
1. I-T-E high interrupting capacity, metal panel circuit breakers.	Safe, positive arc interruption.
2. Metal wiring troughs.	A new degree of protection and long life for control wiring.
3. Instrument transformers designed specifically for use in switchboards.	Lower temperature rise and higher mechanical strength combine for greater safety, longer life.
4. Single horizontal main bus.	More room for cable connections. Cuts installation time and costs.
5. Uniform size and type of operating handles.	Safe, simple and accurate manual operation. Better switchboard appearance.

All I-T-E switchboards and unit substations are factory engineered, assembled and tested. Design features assure you engineering savings, long equipment life and improved appearance.

Get these free descriptive bulletins from your local I-T-E representative or the I-T-E general office, Philadelphia.

6003-D A complete guide to I-T-E 600 V Multumite Switchgear Assemblies.

7000-A Packed with information about I-T-E's newest 5 KV Switchgear.

For *more dependable* Switchgear *specify I-T-E!*

R&IE

I-T-E Circuit Breaker Company • 19th & Hamilton Streets • Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.
Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., N.Y.

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS
MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS

FIELD-PROVED and ACCEPTED

thousands in daily use!

AMPROBE

THE ONLY *POCKET-SIZED* SPLIT-CORE VOLT-AMMETER

Complete with plug-in type voltage test leads and genuine top grain cowhide leather case.

½ the usual size! only 7"

⅓ the usual weight! only 14 oz.

½ the usual price! only $42.75

measures current instantly, safely, accurately without interrupting circuit or breaking insulation!

Thousands of Amprobes have been in daily use for months—in major plants, in famous laboratories, with utilities and government agencies, on construction jobs, in motor repair shops. *Rarely has an instrument been given such unqualified acceptance by users in the field.* This is a real tribute to Amprobe's accuracy, its ruggedness, its soundness of design and construction.

Amprobe has taken the split-core volt-ammeter out of the "heavy equipment" class and made it a *personal* instrument.

AMPROBE* **is so compact, you can slip it into your pocket, or carry it on your belt.**

AMPROBE* **gives you an instant current reading "right on the nose" without touching the conductor or interrupting the circuit. (You just press the trigger to open the spring-controlled jaws; then release the trigger to close probe jaws around the conductor).**

AMPROBE* **is ruggedly constructed and can be roughly handled without fear of breakage.**

Once you've held the Amprobe in your hand, once you've discovered how convenient it is to carry and to use, you'll understand why an Amprobe in the hip pocket is fast becoming the "trade mark" of the up-to-date electrical engineer, maintenance man, electrician, and motor service man. Technical Bulletin sent on request. PYRAMID INSTRUMENT CORP., 49 Howard St., New York 13, N.Y.

THE AMPROBE* IS AVAILABLE IN THREE MODELS:

MODEL A-5	MODEL AS-1	MODEL A-6
AMPERES: 0/6.5/13/26/65/130 amps	AMPERES: 0/6.5/13/26/65/130 amps	AMPERES: 0/10/25/50/100/250 amps
VOLTS: 0/130/260 VAC	VOLTS: 0/150/600 VAC	VOLTS: 0/150/600 VAC

FREQUENCY: 50-70 cycles VOLTAGE BREAKDOWN TEST: 3,000 Volts A.C.

ACCURACY: ± 3% (of full scale deflection) SCALE LENGTH: 2.47 inches

SEND FOR DESCRIPTIVE LITERATURE:

PYRAMID INSTRUMENT COMPANY Dept. EC70
49 Howard Street, New York 13, N. Y.

Please send me Bulletin 109D describing the Amprobe* split-core volt-ammeter.

Name.....

Company.....

Address.....

City.....Zone.....State.....

Our local electrical distributor is:.....

.....

A PYRAMID INSTRUMENT

see it, try it today at all better electrical distributors

THIS WIRE TAKES TOP HONORS IN CHEMISTRY!

Wherever chemicals abound, as in chemical plants, dairies, breweries, seaside areas, mines, well holes, the new Type AZ Cable insulated and sheathed with VINYLITE Brand Plastics is winning top-of-the-class honors!

This non-metallic sheathed cable, reinforced with glass fiber, not only resists alkalies and most strong acids, but has a phenomenal ability to withstand moisture, fungus and aging. VINYLITE Plastic has remained unharmed after seven years' immersion in water—and twelve years' burial in the ground.

In addition, it provides utmost resistance to flame, sunlight, extreme heat, cold, and abrasion.

Non-metallic sheathed cables using VINYLITE Plastic materials are smooth, small in diameter, clean to handle, easy to install, mar- and impact-resistant, and highly flexible. They slip easily through narrow spaces and around sharp corners without damage.

Combining low cost with long life and dependability, these highly chemical resistant cables represent a big advance in general-purpose electric wiring. It will pay you to investigate further. For full information, write Dept. IK-41.

Data courtesy The Plastic Wire & Cable Corp, Jewett City, Connecticut

Vinylite BRAND PLASTICS

BAKELITE DIVISION UCC

BAKELITE DIVISION, *Union Carbide and Carbon Corporation*, 30 East 42nd Street, New York 17, N. Y.

NEW TRUCK MOUNTED CONTACTORS

Cut Inspection Time!

Now, for the first time, air contactors have been truck mounted! The contactors of this Synchronous Motor Controller are mounted on wheels—easy to remove through front or rear hinged doors. Just disconnect the power leads, unplug the control circuits and withdraw the contactors for easy inspection.

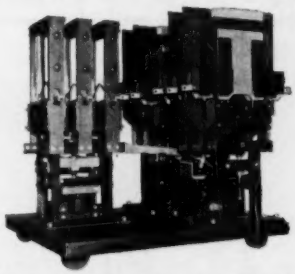
You save space! The starter is smaller because room for inspection isn't needed within the cubicle. Truck mounting is a feature of Type *H* Starters using three air contactors.

For *complete* control plus protection of squirrel-cage, synchronous and wound rotor motors up to 1500 hp at 5000 volts . . . all in one attractive steel cabinet that is compact and easy to install . . . specify Allis-Chalmers Type *H* Starters.

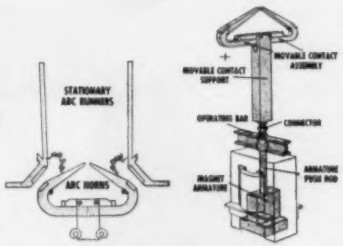
For full or reduced voltage starting, a single starter or an entire control group, check with your nearby A-C representative or send for bulletins 14B6410 and 14B7303.

A-3107

ALLIS-CHALMERS, 930A SO. 70 ST. MILWAUKEE, WIS.



THREE TYPE 256 AIR-BREAK CONTACTORS are mounted on a common base of heavy gauge metal . . . mechanically interlocked to provide reversing and dynamic braking for a synchronous motor. Base is on wheels — rolls into cubicle on guide rails. This truck mounting provides for quick, easy, unhindered inspection.



DOUBLE BREAK CONTACTS AND STRAIGHT LINE VERTICAL ACTION are combined in Allis-Chalmers Air-Break Contactors to eliminate maintenance factors like flexible contact leads, turning shafts and shaft bearings. These contactors are clean, easy to inspect and maintain . . . accessible in compact, attractive Type *H* Starters.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

FOR WIRING OR REWIRING . . .

Modernize the Easier Way

Wrenches or pliers are the only tools needed to tighten the compression-type box connector used with ELECTRUNITE E.M.T. No thread-cutting required . . . just cut the tubing to fit, slip on the fitting and in a few seconds the job is done. It never is necessary to turn the tubing into the fitting!

with ELECTRUNITE E.M.T.

Right from the beginning, lightweight ELECTRUNITE E.M.T. takes the "back ache" out of the raceway installation . . . a good reason why it's mighty popular with journeymen everywhere. In vertical runs . . . cramped, hard-to-reach locations . . . narrow concrete pan openings . . . ELECTRUNITE E.M.T. eliminates many of the problems common with bulky, heavy conduit.

And don't worry about the mechanical or electrical protection provided by this modern raceway material, either. Made of strong open-hearth steel, ELECTRUNITE E.M.T. withstands all normal installation punishment and abuse. It's approved by the National Electrical Code and most local codes . . . and every length carries the Underwriters' Laboratories seal.

Check all of the advantages of Republic ELECTRUNITE E.M.T. Try it on any type of wiring job—exposed, concealed or in concrete. And you'll quickly see why it's easier to modernize any wiring installation when you use modern ELECTRUNITE E.M.T.

Today, more and more contractors are specifying ELECTRUNITE E.M.T. for practically all of their raceway work. Why not follow their example? Your nearest ELECTRUNITE Distributor will be glad to give you the complete story about ELECTRUNITE E.M.T. Call him *today*.

ONLY ELECTRUNITE E. M. T. GIVES YOU ALL 5 OF THESE EASY-TO-INSTALL FEATURES

1. ***Inch-Marking***—Easy-to-read inch and foot marks imprinted on every length of ELECTRUNITE E.M.T. in most popular sizes for easier measurement of bending and cutting distances.
2. ***Light Weight***—Weighing less than half as much as heavy conduit, ELECTRUNITE E.M.T. is easier to carry, easier to handle and easier to install.
3. ***No Thread-Cutting***—Modern compression fittings eliminate need for threads... make strong, leakproof joints in a matter of seconds.
4. ***Knurled Inside Surface***—Actual tests prove that ELECTRUNITE's patented inner surface makes wire-pulling as much as 30% easier.
5. ***Bending System***—A combination of Inch-Marking, patented one-piece ELECTRUNITE Bender and Instruction Tag . . . simplifies all types of bends, stubs and offsets.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC STEEL

Republic ELECTRUNITE E.M.T.

LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY

It's no time to fiddle!

HEADLINES warn us of the menace of spies and subversive agents. But in every community there is a hazard, largely unrecognized, which may become ready tinder for the ravaging flames of socialism and communism. This is the misconception of everyday economic facts that exist among our young people.

For example, a recent poll among high school seniors shows that the majority of them believe that the owners of business take out for themselves a larger share of the income than is paid to employees. They think the stockholders' average return is 24% of the sales dollar. The truth is that stockholders average less than 3%, whereas over 30% of the income dollar is paid out as wages, pensions and other benefits.

Our young people do not seem to realize that paying dividends is only one function of profits. Far more important today is the need for profit to keep business competitive, and to pay for new buildings, machinery, and other necessary equipment and to provide new and more jobs. Ignorance of this fundamental concept breeds contempt for the system of enterprise that built our country and keeps it strong.

The facts of business must be given to our boys and girls to protect their future. Only business men can supply the facts. As a business leader in your community, it is your responsibility to help clear up such misconceptions. The old story that Nero fiddled while Rome burned must not have a counterpart in America.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.

HERE'S WHAT ALLIS-CHALMERS MOTOR "Certified" SERVICE MEANS TO YOU

W. L. Manly, Mgr.
Dealer Sales Dept.
ALLIS-CHALMERS

"THE WORD SERVICE has more meanings than there are definitions in a dime store dictionary. It is often used insincerely as a catchword lure . . . a pretense as shallow as frost on a window. To others, *service is a natural and obligatory* complement of selling . . . helping customers select what best fits their needs, filling the order accurately and promptly, and insuring that performance fulfills the promise.

"The meaning of Allis-Chalmers *Certified Service* is clear and unequivocal. It backs up product performance and assures the buyer that dependable Certified Service is conveniently close.

"It is unique, efficient and sound. *Unique,* because it allies Allis-Chalmers with ***independently*** owned and operated shops. *Efficient,* because it minimizes delay and eliminates heavy transportation expenses. *Sound,* because the work is performed by reliable and experienced concerns.

"This policy is practiced by all of the 83 A-C Certified Service Shops in every major U. S. industrial area."

NEW MOTORS AND CONTROLS, TOO

Remember — your nearest A-C Authorized Dealer or Certified Service Shop also offers a complete line of new motors and controls to 200 hp.

ALLIS-CHALMERS, 930A SO. 70 ST. MILWAUKEE, WIS.

A3112

ALABAMA
Birmingham—Elect. Repair & Serv. Co.
Montgomery—Standard Electric Co.

ARIZONA
Globe—Copper Electric Co., Inc.

CALIFORNIA
San Diego—Calif. Elect. Works
Los Angeles—Larsen-Hogue Elec. Wks.
Oakland—T. L. Rosenberg Company
San Francisco—Weidenthal-Gostiner
San Jose—Rosendin Elec. Works

COLORADO
Denver—Baker Electric Company

CONNECTICUT
Hartford—Charles H. Leppert
Waterbury—Elec. Motor Repair Co.

FLORIDA
Jacksonville—Turner Elec. Works
Miami—Penninsular Armature Wks.
Tampa—Tampa Armature Works

GEORGIA
Atlanta—Braiden-Thompson Elec. Co.
Columbus—Smith-Gray Electric Co.

ILLINOIS
Chicago—Chicago Electric Company
Marion—Giles Armature & Elec. Wks.

INDIANA
Indianapolis—Scherer Electric Co.
Evansville—Evansville Elec. & Mfg. Co.

IOWA
Sioux City—Smith Elec. & Supply Co.

KANSAS
Salina—Cont. Kans. Elec. Mach. Co.
Wichita—Tarrant Elec. Machinery Co.

LOUISIANA
New Orleans—Industrial Electric
Shreveport—Shreveport Arm. & Elec.

MAINE
Brewer—Stanley J. Leen Company

MARYLAND
Baltimore—Keystone Elec. Co., Inc.

MASSACHUSETTS
Lawrence—Roland B. Glines Co.
Roslindale—Ramsey Electric Motors
Springfield—Elec. Motor Repair Co.

MICHIGAN
Grand Rapids—Grand Rapids Ind. Co.
Detroit—Stecker Electric Company

MINNESOTA
Duluth—Mielke Electric Works, Inc.
Minneapolis—Parsons Electric Co.

MISSISSIPPI
Vicksburg—Lindke Electric Company

MISSOURI
Kansas City—Boese-Hilburn Elec. Co.
St. Louis—French-Gerleman Elec. Co.

NEBRASKA
Omaha—Omaha Electrical Works

NEW HAMPSHIRE
Concord—A. S. Tracy

NEW JERSEY
Atlantic City—Charles A. Buckley
Paterson—Elec. Service Repair Co.
Trenton—Lockwood Elec. Motor Serv.

NEW MEXICO
Albuquerque—Powell Electric Co.

NEW YORK
Buffalo—Robertson Electric Co., Inc.
Jamestown—A. E. Westburgh
Mt. Vernon—H. A. Shreck, Inc.
New York—Consolidated Elec. Motor
Rochester—Vanderlinde Elec. Corp.
Utica—Mather Evans & Diehl Co.
Watertown—Watertown Electrics, Inc.

NORTH CAROLINA
Charlotte—Southern Elec. Serv. Co.
Rocky Mount—Hammond Electric Co.

OHIO
Cincinnati—Cincinnati Elec. Equip.
Cincinnati—Electric Service Co.

THERE ARE **83** ALLIS-CHALMERS "Certified" Service Shops THROUGHOUT THE U.S.A.!

Cuyahoga Falls—A-C Supply Company
Toledo—Romanoff Electric Company
Youngstown—Winkle Electric Company

OKLAHOMA
Oklahoma City—Southwest Elec. Co.
Tulsa—Smith-Milligan Electric Co.

OREGON
Eugene—Kalen Elec. & Mach. Co.
Portland—Milwaukee Machinery Co.

PENNSYLVANIA
Johnstown—Universal Elec. Mfg. Co.
Oscoola Mills—Mid-State Elec. Equip.
Philadelphia—Elec. App. Repair Co.
Pittsburgh—Penn. Elec. Coil Corp.
York—Industrial Electric Company

RHODE ISLAND
Woonsocket—Dooray & Barbeler, Inc.

SOUTH DAKOTA
Sioux Falls—Elec. Motor Repair

TENNESSEE
LaFollette—Standard Armature Wks.
Memphis—Ind. Elec. & Supply Co.

TEXAS
Amarillo—G. E. Jones Electric Co.
Dallas—Industrial Elec. Equip. Co.
El Paso—B & M Machinery Company
Ft. Worth—Central Electric Company
Houston—Roy A. Boruntz Company

VIRGINIA
Richmond—Wingfield & Hundley
Roanoke—Virginia Armature Company

WASHINGTON
Spokane—Lee F. Austin Company

WEST VIRGINIA
Charleston—Charleston Elec. Supply

WISCONSIN
Green Bay—Boemster Electric Co.
Milwaukee—Dietz Electric Company
Wausau—Electric Motor Service
Wis. Rapids—Staub's Elec. Shop

READ WHAT USERS SAY ABOUT

G.E.'s New All-Purpose* Insulating Varnish G-E 9574

J. L. Hughes, owner of the J. L. Hughes Electric Company, Columbus, Ohio, says:

"We have found from test and practical experience that General Electric general-purpose varnish 9574 is tops for our work."

J. Lindborg, owner of AAA Electric Motor Service, Atlanta, Ga., says:

"Our experience has been that this varnish is as good as G.E. claims. It gives a good coat on every type of wire, bakes easily and dries to a tough coating that stands up perfectly in service."

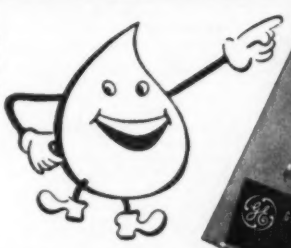
Guy W. Probst, owner of Lockhaven Electric Repair Co., Lockhaven, Pa., says:

"I find that I only use about half as much 1201 Glyptal as a cover coat on 9574 as I had to use over the varnish I had been using, and I get higher gloss and better bonding."

These statements indicate the success of the new G-E 9574. If you are looking for an insulating varnish which bakes at low temperatures, penetrates deep coils easily, and requires no special thinner, investigate G-E 9574.

**G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G.E.'s complete line of electrical insulating materials, including wedges, adhesives, cements, compounds, cords and twines, sleeving, wire enamels, mica, papers and fibers, permafils, tapes, tubing, varnished cloths, and varnishes.*

Here's A Bulletin You Should Have! If you haven't yet tried G-E 9574 get in touch with your local G-E Distributor, or write for our new bulletin to Section K3, Chemical Department, General Electric Company, Pittsfield, Massachusetts.



You, too, can put your confidence in

GENERAL ELECTRIC

"FROM MOLTEN METAL TO FINISHED PRODUCT"

The Heart of Good Electrical Fittings

Every WAGNER Malleable Electrical Fitting for use with thin-wall conduit (EMT) illustrates the value of correct foundry technique and—years of specialization.

Facilities, men, and applied experience are fused together, here at WAGNER's, into a method and "way of doing things" that produces electrical fittings that are RIGHT and "good to work with".

You get tough, accurately cast fittings made in our own foundry under complete chemical laboratory control. Precision threading and finishing gives you malleable fittings of highest uniform quality.

Distributed nationally through leading wholesalers means "next-door" delivery to any part of the country. WAGNER MALLEABLE PRODUCTS CO., 222 W. Adams Street, Chicago 6, Illinois. Foundry and Plant, Decatur 60, Illinois.

Send for new illustrated Catalog 483

Approved by Underwriters' Laboratories, Inc.

WAGNER MALLEABLE FITTINGS

"From Molten Metal to Finished Product"

CRESCENT ENDURITE

New! Improved!

DUAL PURPOSE WIRE & CABLE

Listed By Underwriters' Laboratories As

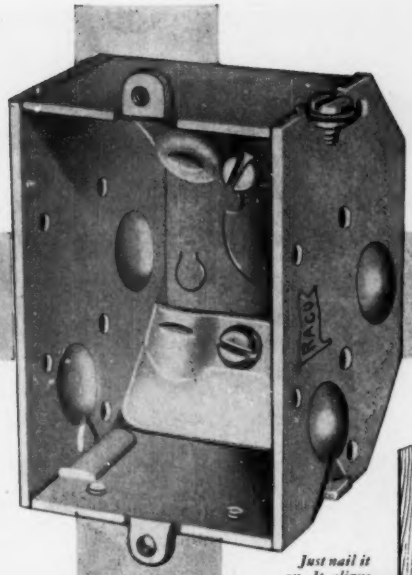
TYPE RH-75° C
or
TYPE RW-60° C

- In DRY locations this wire is rated as a type RH with its high permissible operating temperature and consequent greater current carrying capacity.
- In WET locations this same wire with its excellent moisture-resisting qualities is rated as a type RW.
- Except where voltage drop is the determining factor, ENDURITE when used as a type RH allows greater current-carrying capacity, so smaller size of cable and in many cases smaller size of conduit can be used at less cost than would be required for Type R or Type T or TW for the same load.
- CRESCENT ENDURITE when used in sizes #6 A.W.G. and larger in dry locations will in most cases give the *lowest installed cost per ampere of useful circuit capacity.*

CRESCENT
WIRE & CABLE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

THE BUMPS DO IT

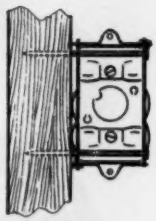


. . . when you nail these boxes directly on studding, they align themselves

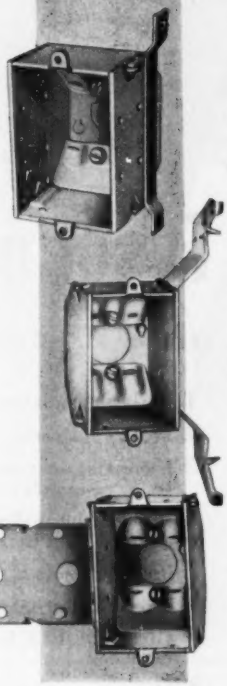
These Raco "economy" switch boxes fasten firmly to studding in new work simply by nailing through the holes provided. It's a fast mount. And you get perfect alignment because the levelling "bumps" have the added height and engineered spacing to line up the box with the studding in exact position. No danger of compressing the sides. Ears have been eliminated for economy.

And—an added Raco feature—the "straight-thru" nail holes are large enough for 16D nails.

This economy style is available in all types of switch boxes . . . all Raco quality, of course.



Just nail it on. It aligns itself.



BRACKET TYPE BOXES

FLAT BRACKET
—this is a sturdy bracket which allows the box to be adjusted to all wall thicknesses.

SIDE MOUNT
—a new bracket on a nationally popular box, especially formed for door frame clearance. The bracket is gauged for standard wall thickness. "Break-off" gauges allow adjustment to all wall thicknesses.

FACE MOUNT
—a newly redesigned bracket, with rounded safety-style corners. Bracket is also equipped with nailing prongs.

RACO

ALL-STEEL PRODUCTS

There's a RACO Bracket Mount Box for Every Job

ALL-STEEL EQUIPMENT Inc.—800 Kensington Ave., Aurora, Illinois

YOU CAN ALWAYS RELY ON RACO

"Not a Single Solenoid Has Burned Out On Our Water Valves Since We Protected Them With FUSETRON dual-element FUSES"

"During the winter of 1948-49 solenoids on five of our water valves burned out due to freezing of the water.

"The replacing coils alone cost us about $50.00 but the labor and operating loss ran much higher.

"To prevent these losses we installed a Fusetron dual-element fuse to protect each coil.

"During the winter of 1949-50 we did not lose one single coil due to burnout — but we did blow quite a few Fusetron fuses.

"The cost of replacing these Fusetron fuses was nothing to the loss we would of had if they hadn't blown."

E. C. Willy, Chief Electrician
H. J. Kaiser Aggregate Plant,
Pleasant, California

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Fusetron DUAL ELEMENT Fuses

give 10-point protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Fusetron DUAL ELEMENT Fuses

Give All-Purpose Protection

because . . . The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Don't Risk Losses

One burned out solenoid
One needless shutdown
One lost motor
One destroyed switch or panel

may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Mail the Coupon Now

for complete information about Fusetron fuses and their 10 point all-purpose protection.

FUSETRON is a trade-mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON Dual-Element FUSES.

Name_____

Title_____

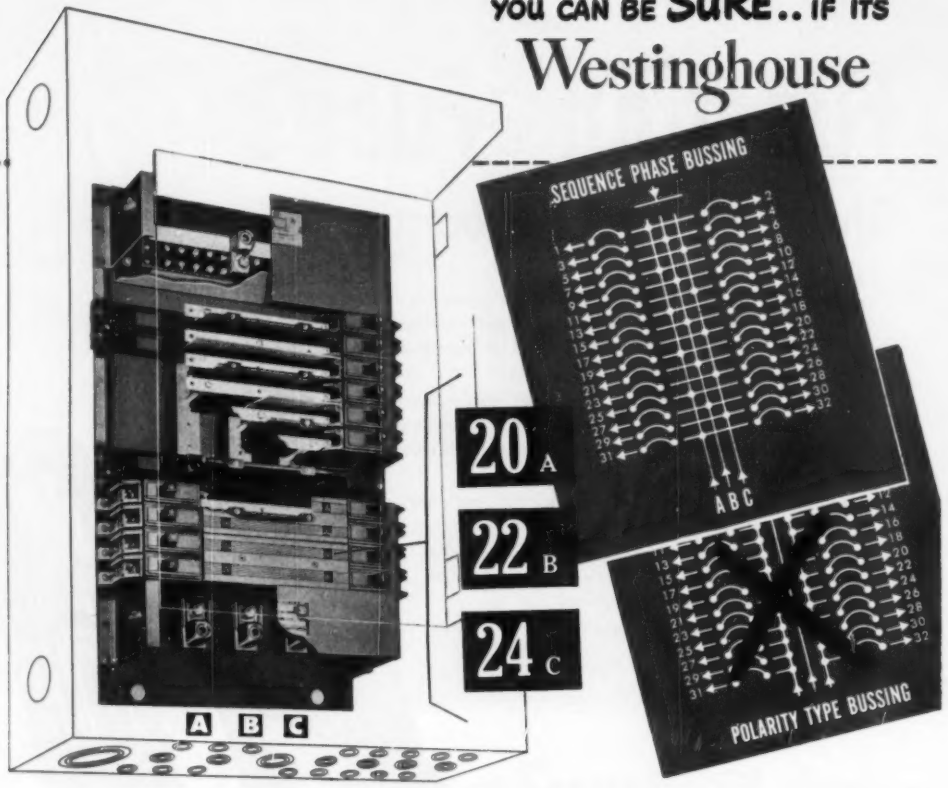
Company_____

Address_____

City & Zone_____ State_____ ECM 7-50

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



HOOKS UP *"easy as A-B-C!"*

Here is a new feature of all Westinghouse 3-phase, 4-wire Lighting Panelboards which cuts installation time and makes inspection easier. Each circuit, and the main bus to which it is attached, is clearly identified by the letters A, B or C.

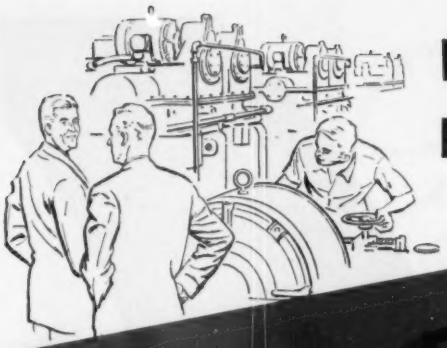
This easy identification is made possible by the sequence phasing method of bussing which is now standard on all of these Westinghouse Lighting Panelboards. Gone is the old polarity-type bussing —the time-consuming "ringing-out" of circuits is eliminated. What's more, this feature that speeds up the hookup is but one of many *extra* details of construction that is standard on all Westinghouse Lighting Panelboards.

To provide local panelboard service in your area, 13 Westinghouse Panelboard Assembly Shops are pin-pointed throughout the country. To get the complete story on Westinghouse Engineered Panelboards, and their moneysaving "extras", contact the Westinghouse Office nearest your phone. Or write for Descriptive Bulletin 30-930 to Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

J-40378

Westinghouse

PANELBOARDS



No wonder production men say . . .

"Delco Preferred!"

There's no better way to assure peak motor performance

- Positioned Bearings
- Delcote Coil Insulation
- Corrosive-Resistant Cast Iron Frame
- Positive Lubrication
- Dynamically-Balanced Rotor and Shaft Assembly
- Water-Tight Conduit Box

"Delco Preferred" . . . It's the engineers' and production men's way of saying, "On this job we want a fine quality motor that's sturdy, rugged, dependable . . . that outperforms all the rest!" Yes, when production men want to reduce motor maintenance and eliminate down time, they specify Delco—the only motor with all the *performance extras* listed at the left.

If you want to get all the facts on Delco Motors, call or write Delco Products, Dayton, Ohio . . . or contact any of the sales offices listed below.

DELCO DAYTON OHIO

DELCO MOTORS

DELCO PRODUCTS, DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

SALES OFFICES: CHICAGO • CINCINNATI • CLEVELAND • DETROIT • HARTFORD, CONN.

Cut Installation Costs

WITH 30% SMALLER

ROCKBESTOS

A.V.C.®

USE A SMALLER CABLE!

With a 230 ampere load you use Size 000 A.V.C. instead of 300 MCM RH*.

SAVE ON CONDUIT!

You use 2-inch conduit rather than 2½-inch conduit.

SAVE ON FITTINGS!

You use smaller fittings—bushings, couplings, terminators, connectors, etc.

SAVE ON LABOR!

Because the cable is lighter, smaller, you can pull it through the conduit easier, faster, and, of course, *cheaper.*

The more efficient current carrying capacity of Rockbestos A.V.C. means plenty of savings for you. Write for the booklet "Cut Current Carrying Costs."

*Comparison with Type RH; 3 conductors in conduit, 40°C — (104°F). See Chapter X, National Electrical Code.

ROCKBESTOS PRODUCTS CORPORATION

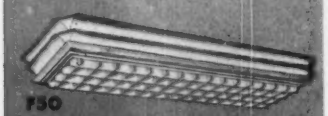
New Haven 4, Conn. • New York • Cleveland • Chicago • Detroit
Pittsburgh • St. Louis • New Orleans • Los Angeles • Oakland, Calif.

Hi ...Your best buy

*Rockbestos A.V.C. has a Higher Ampere Rating

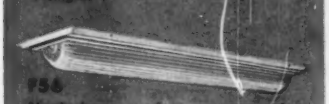
F40

Joleco's new Recessed Fixture for fine store and office lighting . . . available in 2 or 4 lamps with shielding of either Aluminum Louver, Inverted Flush Aluminum Louver, Corning "Alba-lite" Glass, Corning "Fresnel" Lens or Formed "Plexiglas".



F50

A surface or suspension mounted fixture designed as a companion to F40 . . . available in 2 or 4 lamps with shielding of either Aluminum Louver, Inverted Flush Aluminum Louver, Corning "Alba-lite" Glass, Corning "Fresnel" Lens or Formed "Plexiglas".



F56

Single-lamp, surface or suspension mounted fixture . . . ideal for corridors, lobbies, meeting rooms, dining rooms, cafeterias and similar installations . . . streamlined, plastic shield of pleasing appearance, non-breakable, shatter-proof and light in weight.

F510

Four-lamp, surface mounted shielded unit for store lighting . . . Corning "Alba-lite" glass shielding produces shadowless illumination and excellent distribution of light on shelves and displays . . . easily and inexpensively maintained.

F60

Surface or suspension mounted luminaire for factories, warehouses, drafting rooms, laboratories . . . available in 1, 2 or 4 lamps . . . economical in first cost, installation and upkeep.

All of the Joleco fixtures shown can be installed as individual units, in patterns or in continuous rows. They are available for use with pre-heat or instant start Fluorescent and 4 foot or 8 foot Slimline.

ILLUMINATION

Illumineering®

ENGINEERING

THE RESULT OF

Progressive Design

by JOLECO . . . .

Out of our program of continuing research in lighting has come a new concept which we choose to call *Illumineering*—a composite of ILLUMINATION and ENGINEERING.

This *Illumineering* approach "remembers" lighting requirements, efficiency factors, design and appearance, plus installation, maintenance and inspection features. All of these are built into every JOLECO luminaire to insure complete approval by buyer and seller.

We are now compiling our "Illumineering Data Book." Basic *Illumineering* and fixture data is ready. Continuing studies and features will be added as completed. Be sure your name is on the mailing list for this valuable information. Write today.

JOLECO Corporation

Designers and Manufacturers of LIGHTING FIXTURES

2515 BALDWIN STREET ST. LOUIS 6, MO.

4 NEW RLM SPECIFICATIONS AND IMPORTANT REVISIONS

NEW 72" Fluorescent Two-Lamp Open End Porcelain Enamel Unit...
NEW 72" Fluorescent Three-Lamp Open End Porcelain Enamel Unit...
NEW 96" Fluorescent Two-Lamp Open End Porcelain Enamel Unit...
NEW 96" Fluorescent Three-Lamp Open End Porcelain Enamel Unit...
Mean Reflection Factor increased to 82% on 12 RLM Units... Revised Specifications for New Instant-Start Ballasts.
RLM
STANDARD SPECIFICATIONS FOR INDUSTRIAL LIGHTING UNITS
RLM STANDARDS INSTITUTE
RLM STANDARD SPECIFICATIONS
for the following industrial lighting units are contained in this book:
• INCANDESCENT
No. 1 RLM DOME REFLECTOR
No. 2 RLM DEEP BOWL REFLECTOR
No. 3 RLM SYMMETRICAL ANGLE REFLECTOR
No. 18 RLM GLASS-STEEL DIFFUSER
Nos. 19, 20 RLM ALUMINUM REFLECTORS 300-1500 w, concentrating and medium-spread distributions
• FLUORESCENT
Nos. 5, 6 RLM 48" CLOSED END UNITS two and three-lamp
Nos. 9, 10 RLM 48" OPEN END UNITS two and three-lamp
Nos. 22, 23 RLM 48" TWO-LAMP UNITS with LONGITUDINAL SHIELD open and closed end
Nos. 7, 11 RLM 60" TWO-LAMP UNITS open and closed end
Nos. 28, 29 RLM 72" OPEN END UNITS two and three-lamp
Nos. 30, 31 RLM 96" OPEN END UNITS two and three-lamp

This New, Free Book of RLM Specifications Gives You the Up-To-Date Information Needed for BETTER PLANNED LIGHTING

For Better Planned Lighting, everyone who specifies, recommends, buys or sells industrial lighting equipment needs a copy of this new book, officially revised on March 1, 1950 and just off the press. It contains nineteen officially approved RLM Specifications. This book is a valuable aid in measuring illumination, construction and performance standards which are basic to lighting equipment efficiency, economy and ease of maintenance.

New RLM Slimline Lamp Units Included are 4 important, newly-established RLM Standards (Nos. 28-31) for industrial lighting units, designed to utilize the new, longer-length Slimline Fluorescent Lamps. Equipment conforming to these standards and bearing the RLM Label is now available. The minimum RLM Standards established for these Slimline industrial units are based upon extensive tests which have indicated these standards to be essential to satisfactory, efficient and economical performance.

Higher Reflection Factors Higher reflection-factor specifications for 12 RLM Units are among the important revisions to existing RLM Specifications contained in the new RLM Book. The reflection-factor increase from 79% to 82% brings users greater efficiency and more light for the money, widens opportunities for Better Planned Lighting; and increases the importance of specifying units bearing the RLM Label. If you specify, recommend, buy or sell industrial lighting equipment, a copy of this new book, "RLM Standard Specifications for Industrial Lighting Units", is available to you without cost or obligation. Write RLM Standards Institute, Inc., Suite 819, 326 W. Madison Street, Chicago 6, Illinois.

RLM STANDARDS INSTITUTE
INCORPORATED
The letters RLM stand for Reflector and Lighting Equipment Manufacturers

R-5130

Test after Test

has proved the PENN-TAP'S

Unequalled Strength

No other fitting of this type has matched the Penn-Tap in tensile strength, in numerous tests to destruction. The reason is obvious:

The Penn-Tap is more sturdily constructed . . . exceptionally tough silicon bronze alloy and *more of it* (at no added cost).

For taps, service entrance connections, dead ends . . . indoor or out. Quickly installed with ordinary wrench.

ONE PIECE—no loose parts . . . swivels on one locked bolt. Holds tight permanently. 7 sizes, for cables 10 Str. to 1,000 MCM.

Only one other Split Bolt Connector can take as high clamping pressures as PENN-UNION

Hundreds of competitive torque tests, of Penn-Union Split Bolt Connectors against other fittings of this type, have shown:

The Penn-Union Connector is *definitely stronger than all others except one, which closely follows Penn-Union design and is nearly equal.*

Excepting this one similar fitting, the Penn-Union Connector withstands clamping pressures 15% to 55% higher.

MAKE THESE TESTS YOURSELF. We will gladly furnish sample Penn-Union Connectors for tests against any other make. *Just tell us the sizes you are using.*

Sold by Leading Wholesalers

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The *Complete* LINE of CONDUCTOR FITTINGS

PENN-UNION

GUTH LITE-

New Recessed Troffers

"BLOCKS OF LIGHT"
that adapt themselves to *Your* needs

GUTH LITE-BLOX fit the job instead of making the job fit the fixture. Call your nearest GUTH resident engineer today, or write for Bulletin 869-A.

LIGHTING

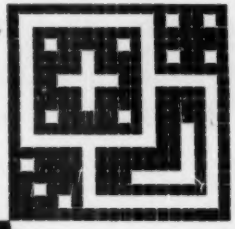
THE EDWIN F. GUTH COMPANY • ST. LOUIS 3, MISSOURI

Leaders in Lighting

BLOX

on the boards:

LITE-BLOX give the designer modular coordination...infinite freedom to use *any* pattern based on 12" grid. New tailored trim (in a choice of smart plated finishes) gives "Hand-Crafted" appearance.



TYPE OF LAMP	NO. LAMPS 1	2	3	4
2'—20W	★	★	★	★
4'—40W	★	★	★	★
5'—85W	★	★		
5' T-17/LB*	★	★		
4'/425 ma.	★	★	★	★
6'/425 ma.	★	★	★	★
8'/425 ma.	★	★	★	★

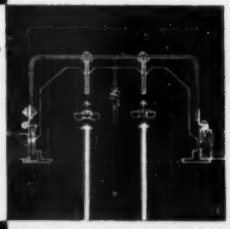
*Low Brightness Lamps

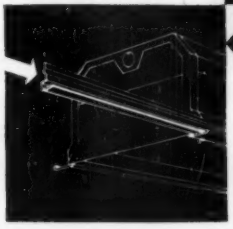
in the lightmeter:

LITE-BLOX give the engineer practically *any* footcandle level or quality of light. *24 sizes* of standard and slimline lamps... a wide range of diffusing and shielding media.

on the job:

LITE-BLOX give the contractor unequalled installation speed and economy. "One-man" hanging with QM Brackets. Complete units ready to mount... no joiners. Exact footlengths...no trimming.





in the stockroom:

LITE-BLOX give the wholesaler a *basic "packaged" unit* that is quickly convertible from flange to teebar or vice versa.

Since 1902

406

University of Buffalo Law School
Buffalo, New York

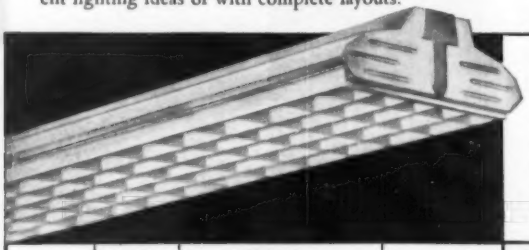
High Quality Lighting
FOR FUTURE LEGAL LIGHTS

NEXT TIME you see an unusual lighting job . . . such as this classroom with 45 footcandles . . . check the manufacturer's name. Frequently you'll find it's Litecontrol.

Why? . . . probably because the outstanding engineers who do the outstanding jobs are never satisfied with second best. They know that Litecontrol fixtures are optically engineered to give more *and better-controlled light* at the least cost. And they know that the extra-sturdiness means more years of service for their clients . . . that other design features mean easier and cheaper maintenance.

So plan your next job around one or more of the many Litecontrol fixtures. If you like, our lighting specialists will be glad to help you with new and different lighting ideas or with complete layouts.

Architects: Duane Lyman & Associates.
Consultant: E. S. Burrows.
Contractor: Robertson Electric Co., Inc.
Lighting Equipment: 30 Litecontrol No. 4124, 2-lamp fixtures, surface mounted.
Lamps: 2-40 watt, white, fluorescent.
Watts per fixture: 100.
Average intensity in service: 45 footcandles.
Watts per square foot: 2.7.
Type of room: classroom.
Dimensions: 27'-6" x 40', 11' ceiling.



The LITECONTROL No. 4124 Fixture . . .

. . . has all those features so essential for good classroom and office lighting — low brightness, trim appearance, evenly illuminated louvres. Louvres are hinged for easy relamping and maintenance. Spring loaded catches allow opening on either side without special tools. Designed for surface, continuous run or pendant mounting.

Cat. No.	No. of Lamps	HOUSING Length	Width	Height	Approx. Ship. Weight
4124	2-40W	49"	12"	5¼"	33 lbs.
4044	4-40W	49"	16"	5¼"	44 lbs.

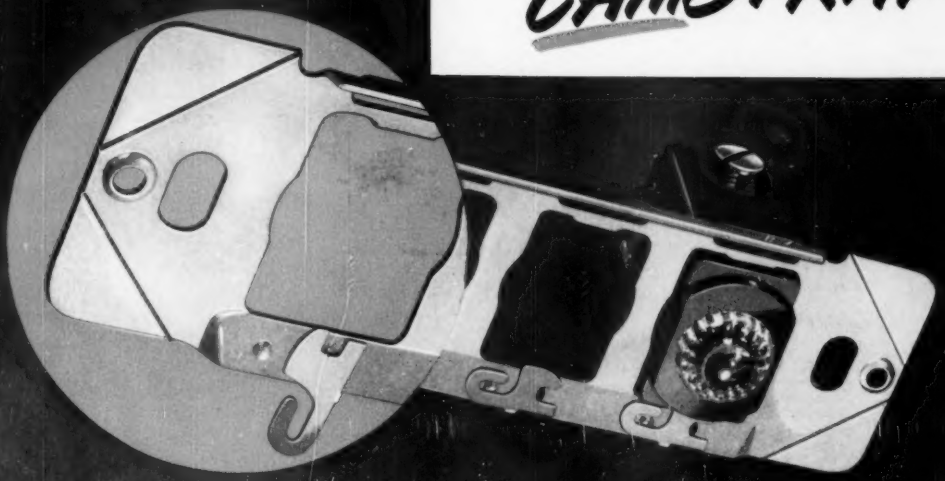
5328 and 5448 available for Slimline lamps.

LITECONTROL CORPORATION
36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

LITECONTROL *Fixtures*
KEEP UPKEEP DOWN

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

new!! the P&S DESPARD CAMSTRAP



...speeds, simplifies P&S-DESPARD installations

Here's a great new addition to a great line—the dependable, interchangeable, precision-built P&S-DESPARD Line. The NEW P&S-DESPARD CAMSTRAP* makes Despard installations faster and easier. The secret of this new P&S-DESPARD CAMSTRAP lies in the cams mounted along one side of the strap. They're easy, speedy to operate. Just open the cam, insert the device, and a flick of the finger locks it securely in place. Devices can be removed just as easily with no strap distortion. Ruggedly made of steel and plated to insure corrosion-resistance, the P&S-DESPARD CAMSTRAP, like all P&S devices, is built to give long service. With the new P&S-DESPARD CAMSTRAP you can add the words "easy" and "fast" to "interchangeable" when you think about the P&S-DESPARD line.

*Patent Applied For

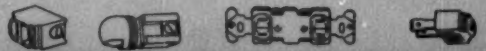
Write today for full information about the interchangeable P&S-DESPARD line.

P&S WIRING DEVICES

PASS & SEYMOUR Inc.

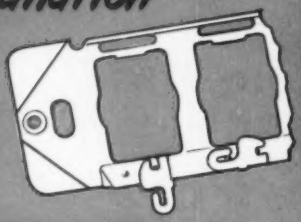
91 Boyd Avenue **Syracuse 9, New York**

Maker of the famous P&S Despard line



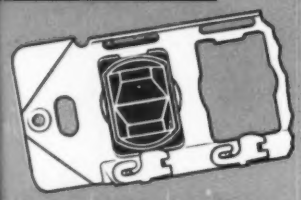
PLEASE TURN PAGE

fast...easy installation

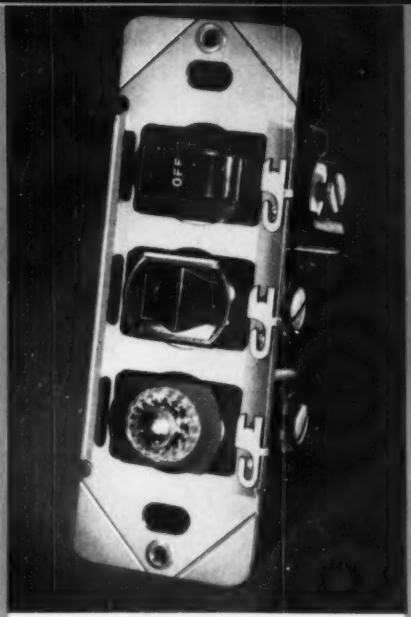


1. OPEN CAM

2. INSERT DEVICE

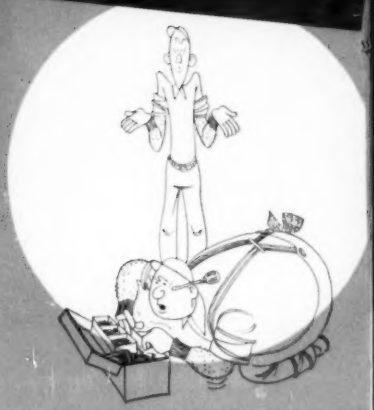


3. CLOSE CAM



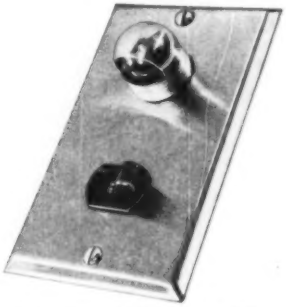
The P&S-DESPARD line is your answer to fast, easy, dependable installations every time. P&S-DESPARD devices are interchangeable, precision-built to give you long, trouble-free service. They meet or exceed all Federal and R.E.A. specifications. All P&S-DESPARD wiring devices carry Underwriters' Laboratories approval.

new!! the P&S DESPARD *CAMSTRAP*



"You don't need a screwdriver when you use the new P&S-Despard Camstrap."

One Cat. No. 1411 Switch and Two Cat. No. 1420 single outlets with a Cat. No. 1881-C Ivory-X plate.



Cat. No. 1339 night light and Cat. No. 1311 single pole switch, with a Cat. No. 1791-B Chrome-X plate.

Cat. No. 1375 flush neon pilot light, Cat. No. 1311 switch and Cat. No. 1320 convenience outlet, with Cat. No. 91031 brown bakelite plate.

PLEASE TURN PAGE

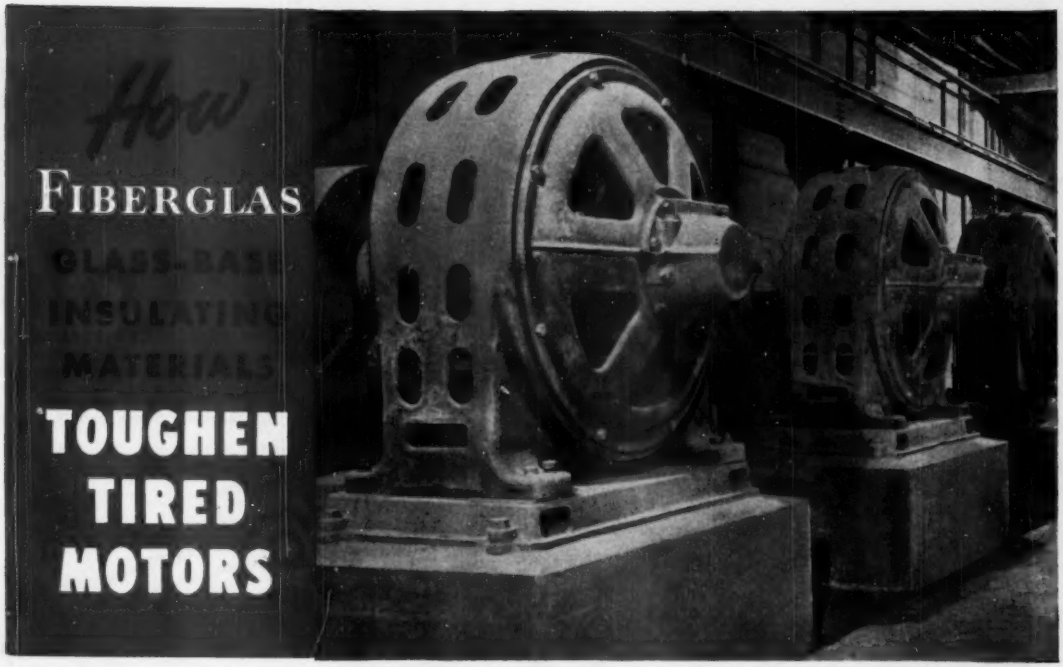
FREE! A sample P&S-Despard Camstrap is yours for the asking. Write for it today!

P&S WIRING DEVICES

PASS & SEYMOUR Inc.

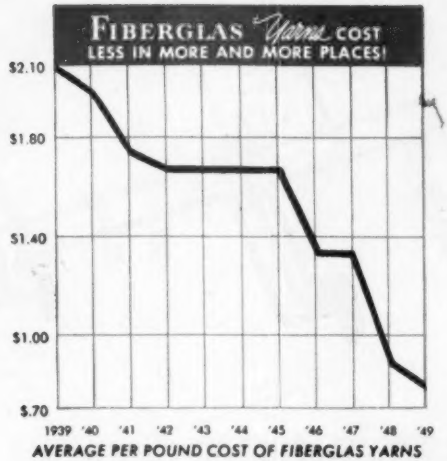
91 Boyd Avenue **Syracuse 9, New York**

Makers of the famous P&S Despard line



OWENS-CORNING
FIBERGLAS

REWINDS HELP INCREASE *Motor Power and Service Life*



AVERAGE PER POUND COST OF FIBERGLAS YARNS

Problem: to reduce motor failure in a dust-laden cement mill where—to fill demands for added production—motors are pushed past their rated power, hour after hour.

Solution: this mill rewound with *Fiberglas glass-base insulating materials,* and got greater resistance to overload heat, abrasive dust, other operating hazards than had ever before been possible with organic insulation. What's more, the inherent space-saving characteristics of Fiberglas yarns helped in re-designing the 150HP motors to 175HP and the 200HP motors to 225HP, in the same frames.

Result: greatly reduced motor failure . . . less costly "down time" . . . increased mill production!

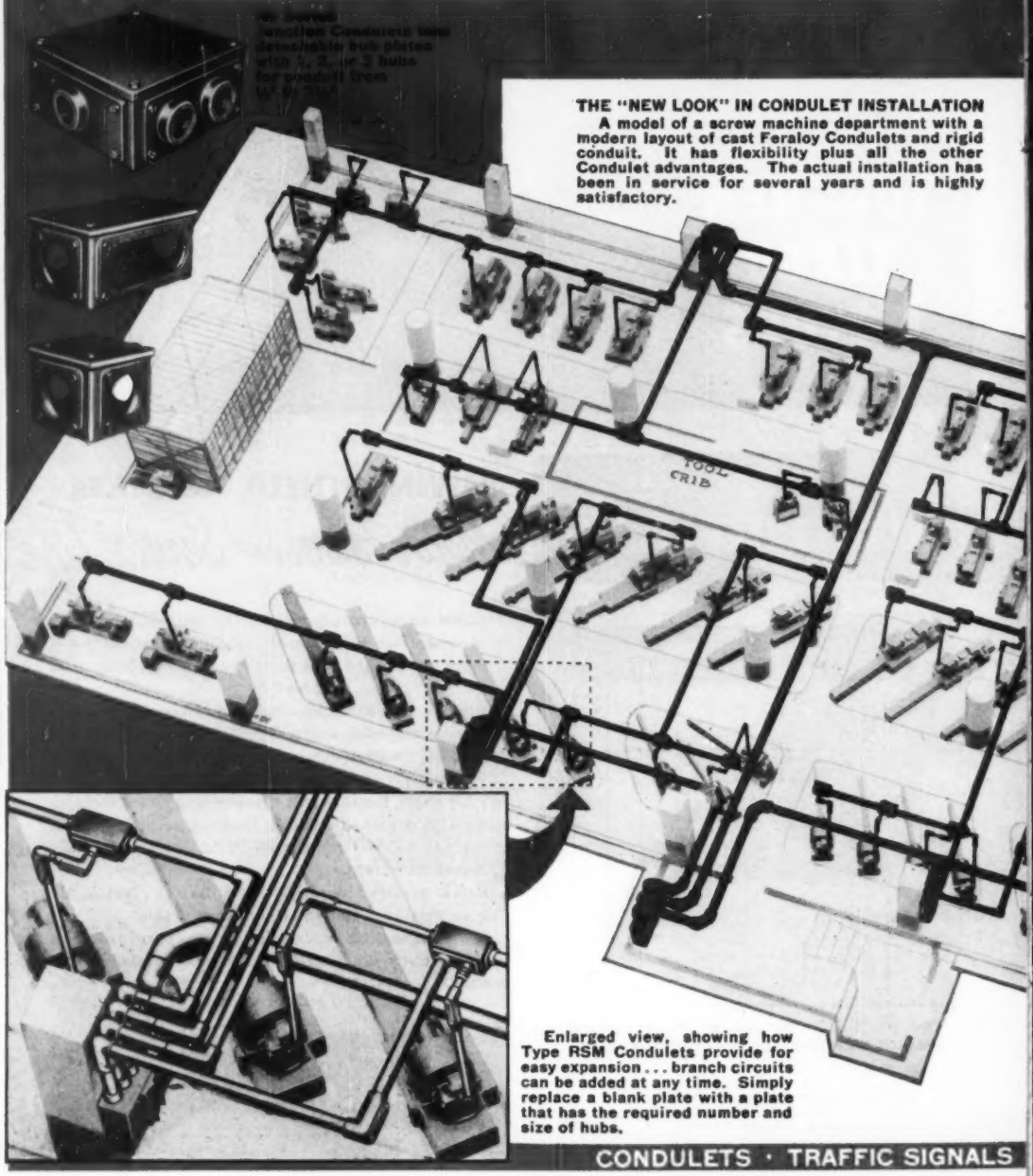
If your operation poses a similar insulation problem, help solve it with Fiberglas glass-base insulating materials!

OWENS-CORNING
FIBERGLAS *Yarns*

*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

OWENS-CORNING FIBERGLAS CORPORATION, Dept. 856, 16 E. 56th St., New York 22, N. Y.

for MODERN WIRING... the conduit and CONDULET*



THE "NEW LOOK" IN CONDULET INSTALLATION

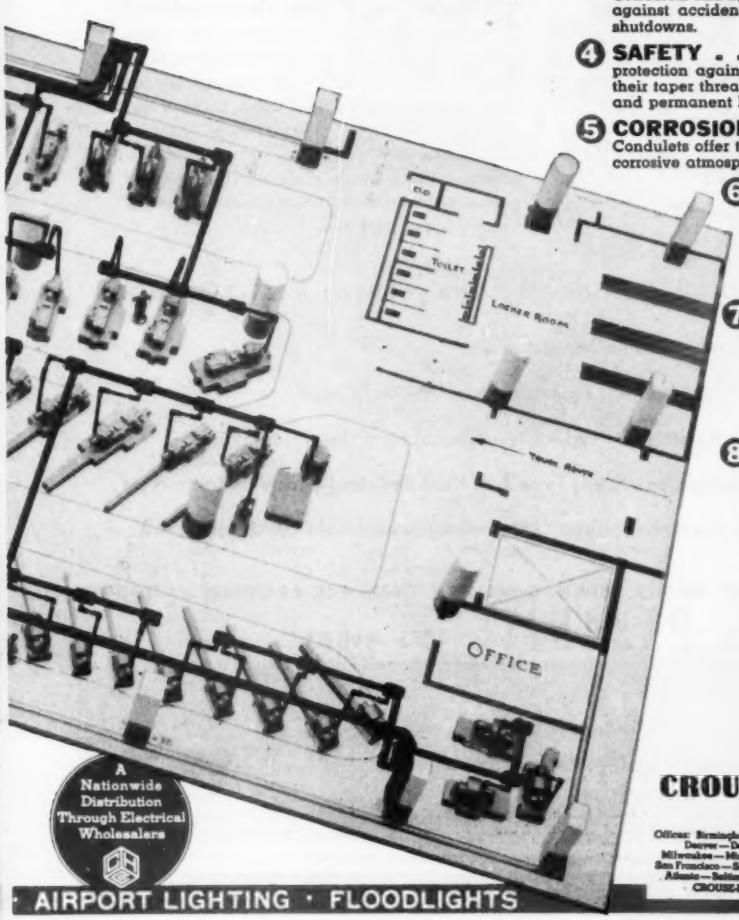
A model of a screw machine department with a modern layout of cast Feraloy Condulets and rigid conduit. It has flexibility plus all the other Condulet advantages. The actual installation has been in service for several years and is highly satisfactory.

Enlarged view, showing how Type RSM Condulets provide for easy expansion ... branch circuits can be added at any time. Simply replace a blank plate with a plate that has the required number and size of hubs.

CONDULETS · TRAFFIC SIGNALS

method gives YOU definite advantages!

NEW ways of using the familiar Condulet and conduit material have produced outstanding results. Modern installation layouts meet industry's modern needs for flexibility while retaining the enduring protection and safety that can only be given by cast Feraloy Condulets and rigid conduit.



1 FLEXIBILITY . . . A modern Condulet installation, like the one illustrated below, provides for the vigorous growth and changing conditions of a modern industry. The RS Series Condulets with their detachable hub plates make it easy to change circuits or add additional circuits at any time.

2 UNIVERSAL APPLICATION . . . Galvanized Condulets and galvanized rigid conduit may be used under all atmospheric conditions and occupancies.

3 MECHANICAL PROTECTION . . . Cast Feraloy Condulets and rigid conduit provide the best possible protection against accidental damage to the wiring — prevents costly shutdowns.

4 SAFETY . . . A Condulet installation gives maximum protection against personal injury and fires. Condulets with their taper threaded hubs and rigid conduit provide a reliable and permanent low resistance path to ground.

5 CORROSION RESISTING . . . Cast Feraloy Condulets offer the best protection wherever moisture, dust or corrosive atmospheres are present.

6 ECONOMY . . . Direct comparison of Condulet and rigid circuit installations with other wiring methods show comparable installed costs. The durability, safety, and low maintenance cost of Condulet installations produces savings which pay dividends over the years.

7 QUALITY . . . All Condulets are built to Crouse-Hinds' high standard of quality with painstaking care by skilled craftsmen. Thousands of Condulet installations that are still in active service after twenty, thirty, forty or more years offer positive proof that the trademark CONDULET stands for reliability and long life.

8 VARIETY . . . Thousands of types and sizes of Condulets, plugs and receptacles, and lighting fixtures are listed in the Condulet Catalog, including a complete explosion-proof and dust-tight line for use in hazardous locations. There is a Condulet for every purpose.

On your next electrical layout, whether modernization or new construction, plan to get all of the benefits of sturdy cast Feraloy Condulets and rigid conduit. Send for additional information on modern Condulet installation.

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

A Nationwide Distribution Through Electrical Wholesalers

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Syracuse 1, N. Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. San Francisco — Seattle — St. Louis — Washington. Resident Representatives: Albany Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va. — Salt Lake City
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· AIRPORT LIGHTING · FLOODLIGHTS

PARANITE
INSULATED WIRES AND CABLES - - will *Give a Great Performance*

FOR sixty years Paranite Quality electrical wires, cables, and cords have been manufactured in our Indiana factories. These facilities to serve our trade are strategically located in Jonesboro and Marion, Indiana and are supplemented by warehouse facilities with stock inventories in principal distributing centers. Paranite distributes its many products through wholesale distributors of electrical merchandise.

✻ *PARA — ("CAOUTCHOUC," TO THE NATIVE) MEANS RUBBER*

PARACOTE—Means (Quality Controlled) Building Wire

PARAFLEX—Means (Quality Controlled) Non-Metallic Sheathed Cable

PARASYN—Means (Quality Controlled) Type T.W. Thermoplastic Insulated Wire

PARATHERM—Means (Quality Controlled) Type R.H. Heat Resistant Grade Building Wire

PARAUSE—Means (Quality Controlled) Type "RR" Underground Cable (600 Volts)

SPECIFY AND BUY — THESE GREAT NAMES MEAN QUALITY — THEY ARE PARANITE PRODUCTS

IF IT'S PARANITE IT'S RIGHT!

DISTRIBUTED THROUGH WHOLESALERS

PARANITE WIRE AND CABLE
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WAREHOUSES AND SALES OFFICES: Atlanta, Ga.; Boston, Mass.; Chicago, Ill.; Cleveland, Ohio; Dallas, Texas; Detroit, Mich.; [illegible]

EXPORT SALES OFFICE—LIONEL-ESSEX INTERNATIONAL CORPORATION, 15 E. 26th ST., NEW YORK 10, N. Y.

ELECTRICAL WIRES AND CABLES *"BETTER THAN CODE REQUIRES"*

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

Don't be a FIXTURE PICKER!

They'll never find a "bargain in lighting" by "picking fixtures". Yet you meet hundreds like this every day. And so do we.

No *one* fixture will solve all lighting problems.

There are, in fact, literally thousands of luminaires engineered to do specific jobs. One may be the right answer—or it may take two or three.

Good lighting combined with practical economics takes the services of a qualified lighting engineer.

Whether you plan lighting, buy lighting or install lighting, the services of a Westinghouse lighting engineer are available to you. J-04280

WESTINGHOUSE

Westinghouse
PLANNED LIGHTING PAYS

products for every industrial need...

from beginning...

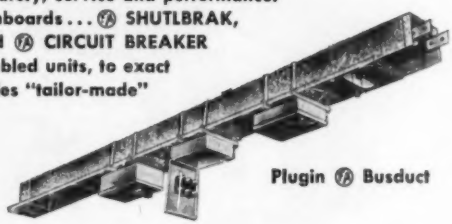
Ⓕ Klampswitchfuz

ALL ALONG THE PRODUCTION LINE, from power source to machines, industry's power and light requirements are being served, *and served well,* by Ⓕ PRODUCTS.

A featured product in this dependable line of electrical equipment is the Ⓕ SWITCHBOARD. This modern, efficient power center is the engineering result of more than 58 years of electrical manufacturing experience... a long record of quality workmanship and design that reflects itself in such features as safety, service and performance.

Each of the Ⓕ Switchboards... Ⓕ SHUTLBRAK, Ⓕ KLAMPSWITCHFUZ and Ⓕ CIRCUIT BREAKER ...are built from standard, pre-assembled units, to exact specifications... making final assemblies "tailor-made" without destroying the savings and advantages of standardized equipment.

From sub-station to switchboard to machines, power will follow the path of least expense via

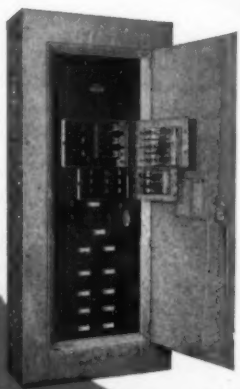


Plugin Ⓕ Busduct

FEEDER Ⓕ BUSDUCT. This efficient distributor of heavy current is designed to team-up with PLUGIN Ⓕ BUSDUCT to give greater flexibility and economy to electrical distribution systems. By providing convenient plug-in outlets every foot of the way, there's always a ready power source for new or present equipment anywhere along the production line... just plug-in anywhere ...anytime... and let 'er roll.

Another Ⓕ Product that bridges the power gap from power source to machines is the Ⓕ FEEDER PANELBOARD. This compact panelboard is unexcelled for the distribution of current through assemblies of standardized switching units, either pull-out or hinged pull-out types.

A variety of dependable panelboards for light and power distribution are manufactured by Ⓕ. These include the Ⓕ LNTIP type

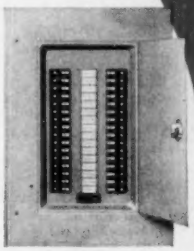


Ⓕ Feeder Panelboard

Ⓕ LNTIP

with tumbler switch and plug fuse branches and "sequence bussing" for better balance of load... Ⓕ THERMAG or DUBLBRAK CIRCUIT BREAKER types for *automatic*, fuse-less circuit protection ... Ⓕ PULFUZSWITCH for disconnect service on lighting and feeder branches and power circuit branches...

Ⓕ COLUMN TYPE to mount between the flanges of "H" columns and save space *on the job*... and Ⓕ DUSTITE for sealing out the hazards of carbon black, coal or coke dust, grain dust and other hazardous dust conditions.



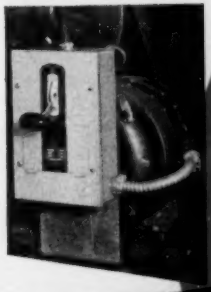
Ⓕ Thermag

Ⓕ Column Type

Ⓕ Dustite

At the end of the power line, Ⓕ SHUTLBRAK SWITCHES are ideal as individual operating switches for motor disconnect. They are front operated, horsepower rated industrial switches with quick make and break operation and interlocking fuse doors that permit access to fuse compartment only when switch is "off." (A special release is provided for authorized persons.)

Ⓕ Shutlbrak Switch



So all along the production line, Ⓕ has a product for every industrial need... plus a coast-to-coast organization of Sales Engineers who will gladly furnish latest engineering data on Ⓕ PRODUCTS or render a complete survey and report on specific electrical problems... all without obligation, of course.

So contact your nearest Ⓕ REPRESENTATIVE (he's listed in Sweet's)... or, if you prefer, write direct to Headquarter's Office for information on Ⓕ PRODUCTS.

...to end!

FA TRADE MARK

Frank Adam Electric Co.

ST. LOUIS 13, MISSOURI

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

SPOT
YOUR POWER

GET MORE PRODUCTION out of every dollar you spend on electric power . . . put dry-type transformers at load centers. Here's what happens: (1) Shorter secondary runs reduce lost power in the line. (2) Better regulation improves output. For example, a 10% correction in voltage will recover a 30% illumination loss . . . 20% motor starting torque loss . . . 19% loss in output of heating operations!

EASY MOUNTING RIGHT AT LOAD GIVES YOU MAXIMUM SAVINGS!

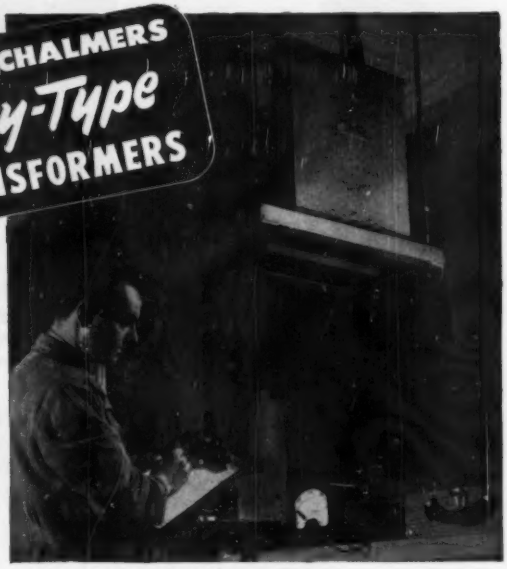
And the closer you locate these transformers to the load the greater your savings will be. That's why the flexibility of locating Allis-Chalmers "dry-types" is an important advantage. You spot them right at the load center. No fireproof vaults needed.

Transformers stocked country-wide in popular ratings. Get bulletin 61B6382A from your A-C sales office. A-3024

ALLIS-CHALMERS, 930A SO. 70 ST.
MILWAUKEE, WIS.

ON WALLS, RIGHT NEXT TO LOAD! Hookup is easy with roomy terminal compartments, accessible through removable front and bottom plates on 10 kva and below single phase, and 25 kva and below 3 phase. On 15 and 25 kva single phase, connections made by removing top cover.

ALLIS-CHALMERS *Dry-Type* TRANSFORMERS

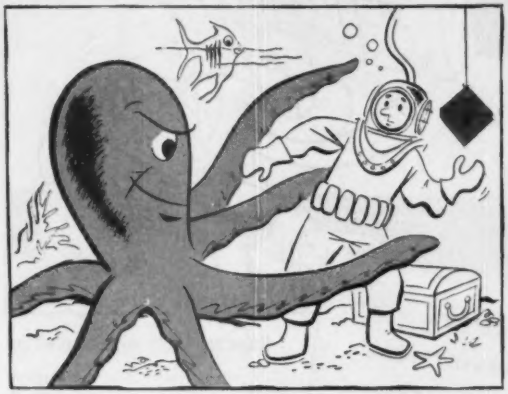


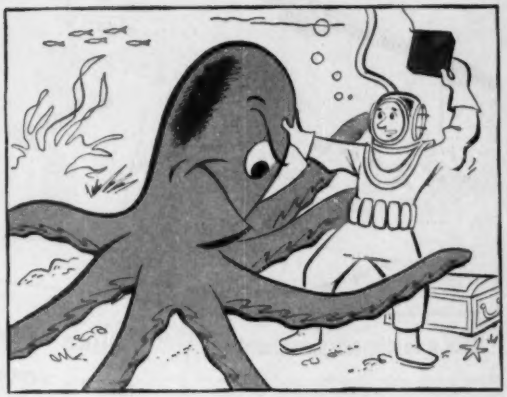
RIGHT ON THE EQUIPMENT IT SERVES! . . . on machines, presses, electric ovens, electronic heaters, etc. Relocation of equipment or shifting loads is no problem — versatile Allis-Chalmers "dry-types" are easily relocated to follow the load.

ON POSTS OR PLATFORMS! You make connections *fast* with solderless clamp connectors on units 15 kva and up single phase, 37½ kva and up 3-phase. Terminals immediately accessible by removal of clamped top cover.

ALLIS-CHALMERS

You can do a *lot*





with a *little*

GOLD SEAL TAPE

Rush job? Use Gold Seal, it's quick and easy to apply. It *goes further* too! Because there's no waste, you get full value from every roll.

Laboratory-control of production assures plenty of tack, from end to end. Gold Seal sticks to the job, conforming readily to the contour of the work.

A pleasure to use, it tears evenly and quickly, does not ravel. Gives a tighter, longer-lasting bond. Does not dry out or peel.

Linemen, electricians,—any tape users like Gold Seal. It helps them get better taped joints in less time . . . in any weather. Its cellophane wrapping keeps it factory *fresh*. You can buy Gold Seal in convenient ten-roll containers, or by the single roll. Jenkins Bros. (Rubber Div.), 100 Park Ave., New York 17, N. Y.

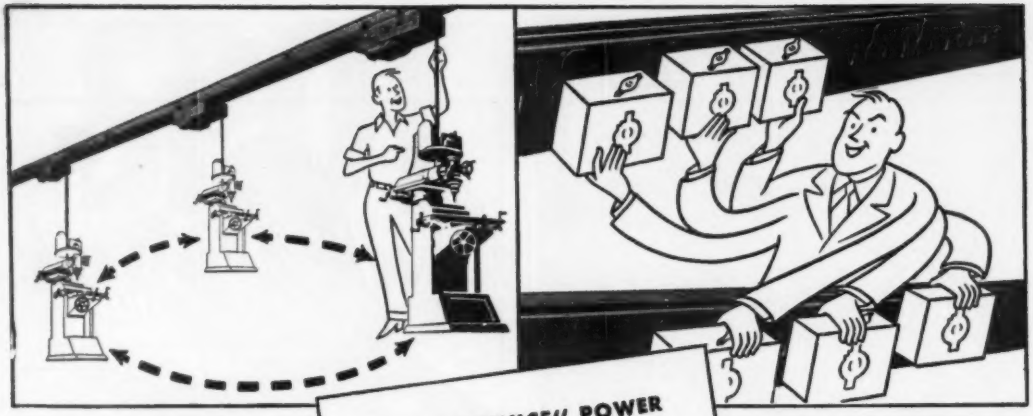
Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet both ASTM and Federal Specifications.

JENKINS *Gold Seal* *Tapes*

TRADE JENKINS MARK Jenkins Bros.

FRICTION and RUBBER TAPES

MADE BY JENKINS BROS., MAKERS OF FAMOUS JENKINS VALVES



"CURB SERVICE" POWER KEEPS YOUR ELECTRICAL DISTRIBUTION SYSTEM

Always Flexible

Like a continuous panelboard

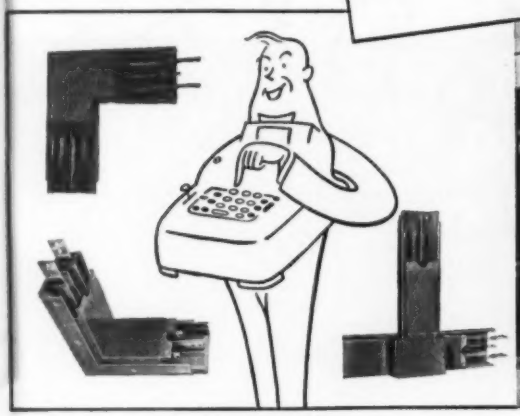
How much time, trouble and money *could* you save if your electric power came off a panelboard running the *entire length* of your plant?

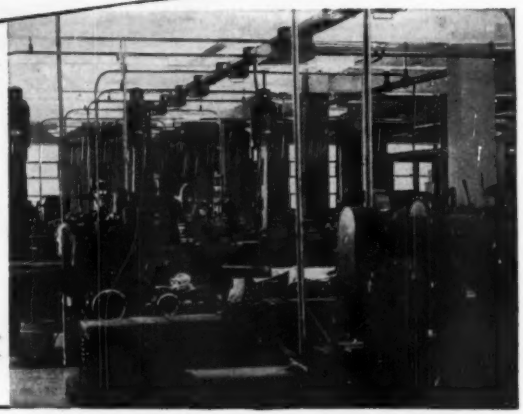
That, in effect, is FVK FLEX-A-POWER* — pre-fabricated busway for 225-1000 amps, 600 volt secondary feeder systems. It's as convenient as curb service — wherever you put a machine, *there's* an outlet.

Relocate loads without rewiring

Every 10-ft section of FVK busway has 15 outlets. You can plug in right at the load . . . rearrange or add loads without rewiring or bothering with extension wires.

Even in cases of major alterations, you can quickly dismantle FLEX-A-POWER, move and reinstall it with practically 100% reuse of materials.





Cheaper to install, too

Standardized parts—straight lengths, elbows, offsets, etc.—delivered to job ready for installation . . . quickly, easily coupled and suspended to conform to any plant layout . . . keep installation time and costs *low!*

Maintenance cost is cut to the bone. Housings resist entrance of dirt and moisture. Materials are made to last.

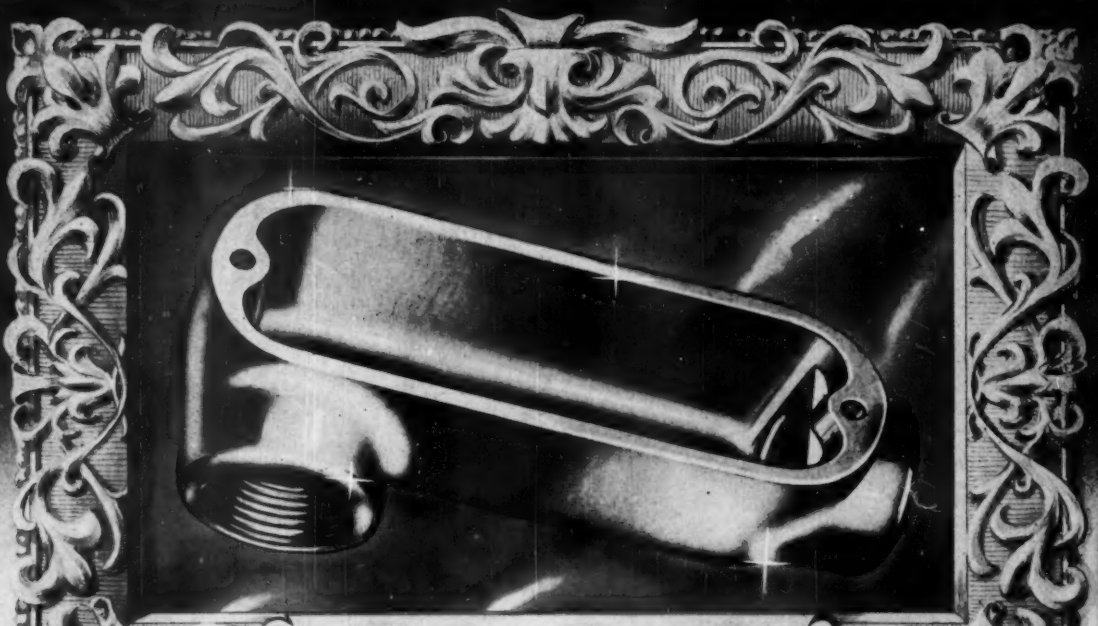
Remington Rand's Laboratory of Advanced Research at South Norwalk, Conn., saves much time and money by keeping its electrical system flexible. Machinery is quickly relocated without lengthy shutdown. Write for new booklet TEB-4,

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY
Plainville, Conn.

*Reg. Trade Mark

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS



FITTING MASTERPIECE by Killark

THE *FIRST* FITTING IN MALLEABLE DIE-CAST* ALUMALLOY

Tested and accepted *in the field*, this Killark (6-Ways-Better) fitting stands out as a new major achievement in design and construction. Die-cast under 10,000 lbs. pressure . . . made of new Allumalloy which combines strength and malleability with the recognized advantages of aluminum . . . it climaxes seven years of concentrated metallurgical research, yet costs no more than ordinary fittings.

First with ALUMALLOY FIXTURES, too

• A COMPLETE, ALL-PURPOSE LINE

Vapor and Explosion-Proof Lights and Fittings . . . Service Fittings . . . Couplings and Connectors . . . Conduit Bodies . . . Flush Switch Fittings.

*Pat. Pending

Killark invites your comparison.

60% LIGHTER THAN IRON—easier to handle.

NON-CORROSIBLE and weatherproof *clear through* . . . resists chemical corrosion—will not rust!

MALLEABLE—enough "give" to withstand shock and strain far beyond job demands.

SMOOTH INSIDE AND OUT—satin-like finish prevents wire skinning, insuring insulation protection.

CLEAN-CUT THREADS make work simple . . . assure precise fitting and longer, trouble-free service.

NON-SPARKING—Alumalloy is completely safe . . . eliminates possibility of fire and explosion.

Write for full information.

K KILLARK ST. LOUIS *Killark*

ELECTRIC MANUFACTURING COMPANY

Vandeventer and Easton Aves. **St. Louis 13, Missouri**

SALES OFFICES and WAREHOUSE STOCKS	BOSTON	156 Purchase St.	PITTSBURGH	298 Duquesne Way	SAN FRANCISCO	1123 Harrison Street
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the "Dutch Brand" trio... THREE ELECTRICAL TAPES

Not one... but all three!

ALL THREE TAPES ARE IMPORTANT
TO MEET THE SPECIFICATIONS of the ELECTRICAL TRADE

Available in practical sizes and packaging for convenient use

"DUTCH BRAND" PLASTIX Friction and Rubber Tapes

No one tape can fulfill the requirements of all jobs . . . it takes the three basic insulating tapes DUTCH BRAND PLASTIX, Friction and Rubber . . . each with different properties . . . to meet the specifications of the electrical field. DUTCH BRAND offers a complete line so that selection can be made.

"DUTCH BRAND" insulating tapes have been well known for forty years as quality tapes, and you can select and depend upon any of them to meet specifications.

They are available at your jobber's.

DUTCH BRAND

VAN CLEEF BROS. INC.
Manufacturers . . . Rubber Products . . . Est. 1910
CHICAGO 19, U. S. A.

Because IT *MUST* BE RIGHT

You can count on

TRIANGLE

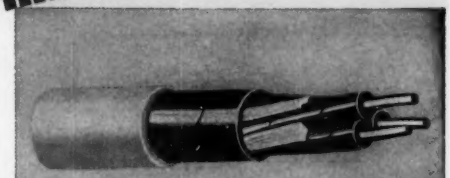
You can see for yourself that it takes massive machines to turn out lead covered and high voltage cables to meet today's rigid specifications. But machines alone cannot do the job: behind them must be men of many years' experience in making cable — in making it *right*.

At Triangle's efficient New Brunswick plant you will find modern machines manned by true craftsmen, checked by rigorous inspection, backed by unceasing development and research. To you, this means the finest in parkway...power...varnished cambric ...lead covered cables that can be constructed — today's top value in wire and cable.

Whether your needs are for standard cables built to I.P.C.E.A. recommendations, or for special cables tailor made to your own specifications, you will find Triangle engineers glad to consult with you.

TYPE RLJFJ

PARKWAY CABLE

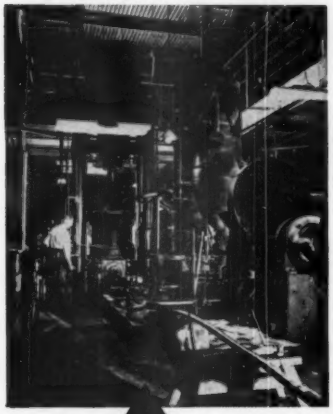


TYPE VML

LEAD COVERED CABLE

TYPE V

VARNISHED CAMBRIC CABLE



Protection Plus—This huge press produces a smooth, uniform sheath of virgin lead for utmost cable protection.

The Trade Mark Of Top Value

TRIANGLE CONDUIT & CABLE CO., INC.

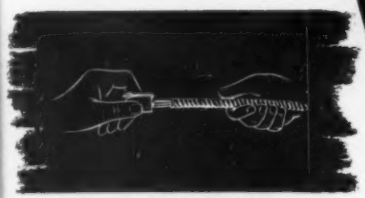
1908 JERSEY AVENUE • NEW BRUNSWICK, NEW JERSEY

IT *MUST* BE RIGHT!

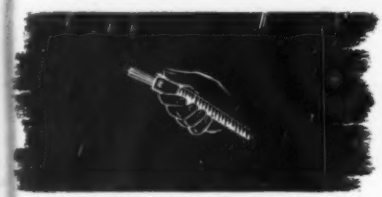
"GLAZON" BUILDING WIRE • BARE WIRE • ARMORED CABLE • "GLAZON" NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE, SERVICE DROP, VARNISHED CAMBRIC BRAIDED OR LEADED, TRIOPRENE TRENCH, POWER AND PARKWAY CABLES • RIGID CONDUIT HOT-DIPPED GALVANIZED • ELECTRIC METALLIC THIN WALL CONDUIT • FLEXIBLE STEEL CONDUIT

It's New! It's Different! It's Easier to use!

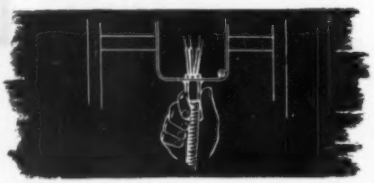
SnapX



INSERT cable in **SNAPX** connector.



COMPRESS spring clip that holds cable.

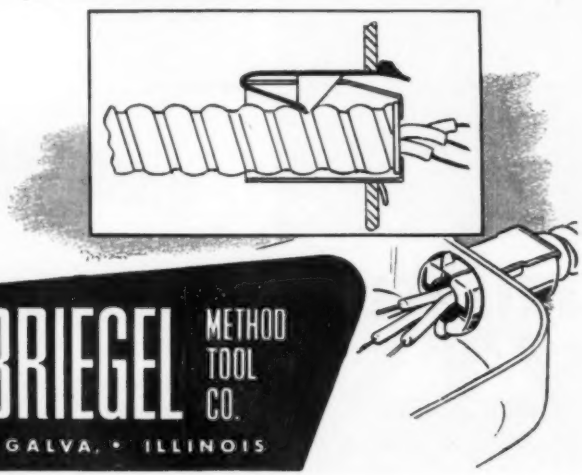


SNAP IN to box knockout and the cable is set — the job done!

The Entirely New Connectors For Armored and Non-Metallic Cable That You Just Snap Into Place!

SNAPX is the new cable connector that is installed without tools. There are no nuts or screws to tighten. Just compress, snap it in place and it's set.

To try it is to buy it. See how easy SNAPX is to use! Write today for your free sample, giving the name and address of your electrical wholesaler.

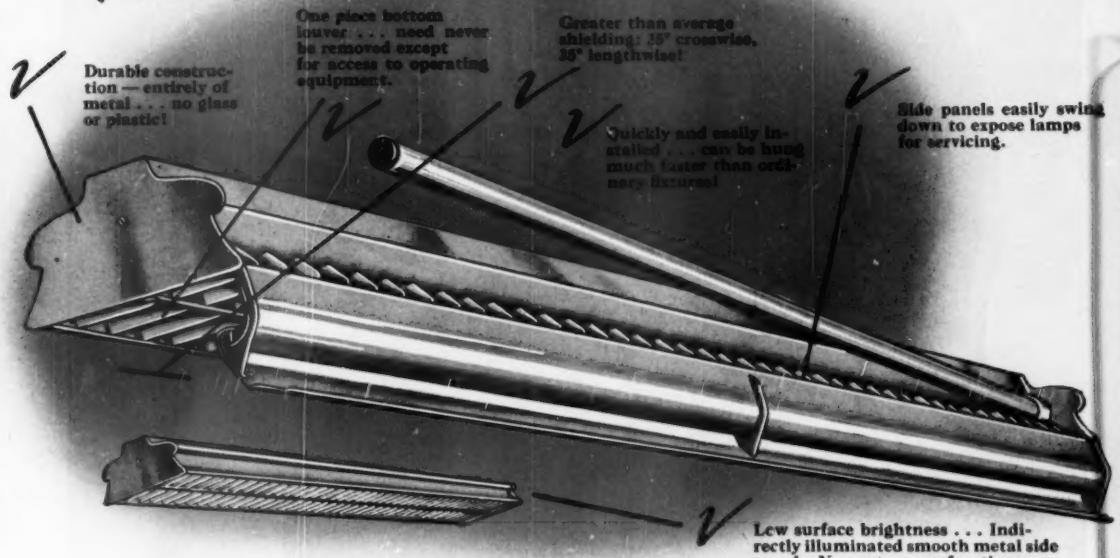


BRIEGEL METHOD TOOL CO.

GALVA, • ILLINOIS

Why monkey around?

This unit has everything!


Durable construction — entirely of metal . . . no glass or plastic!
One piece bottom louver . . . need never be removed except for access to operating equipment.
Greater than average shielding: 35° crosswise, 35° lengthwise!
Quickly and easily installed . . . can be hung much faster than ordinary fixtures!
Side panels easily swing down to expose lamps for servicing.
Low surface brightness . . . Indirectly illuminated smooth metal side panels. No vents or perforations. Makes cleaning easier . . . faster!

Here it is — the perfect fixture for Commercial Lighting! This new Wheeler O. C. Slimline unit is the answer for illuminating Offices, Schoolrooms, Stores, Drafting Rooms, Hospitals and Public Buildings. Attractive, economical and efficient.

Made for use with two 75 watt, 96" T12 Slimline lamps and two 40 watt, 48" T12 single pin lamps. Write Wheeler Reflector Company, 275 Congress St., Boston 10, Mass. . . . Also New York, N. Y. Representatives in principal cities.

O.C.

OCULAR COMFORT

Wheeler REFLECTORS

Distributed Exclusively Through Electrical Wholesalers

MADE BY SPECIALISTS IN "SKILLED LIGHTING" EQUIPMENT SINCE 1881

Announcing...

Rome RoFlex is Underwriters' Laboratories approved for 600 volts. Available in 2 and 3 conductor sizes, with or without ground wire. Packaged for convenience of handling in individual cartons. Order it from your electrical wholesaler today.

Rome RoFlex NON-METALLIC SHEATHED CABLE

With New GRAY FINISH

SURFACE MARKED FOR EASY IDENTIFICATION

Here is the answer to an electrican's prayer . . . a non-metallic sheathed cable with a finish that is smooth for easy pulling, clean to handle, non-flaking and clearly printed with size and name for easy identification. Yes, Rome's new gray finish is an improvement you *cannot afford to pass up.* There is no need to wear safety goggles when you work overhead with the new RoFlex. Its finish will not flake or dust off . . . does not get tacky . . . leaves you with clean hands.

Under the new gray finish, Rome RoFlex has the same high quality construction as before. It is easy to strip, smaller in diameter and light in weight. Its outer braid is a combination of glass and presaturated yarn for high resistance to mold and rot.

On your next "flex" job save time and money by insisting upon the new Rome RoFlex with the *gray finish.*

IT COSTS LESS TO BUY THE BEST

ELECTRICAL WHOLESALERS:

These Rome Cable Products Mean *Extra* Business for You

Special Wholesalers Packaged Weatherproof Wire

Here is a special 500' carton package of Weatherproof for handy contractor use. If you are not pushing this item, you are missing a fast seller. Originated by Rome for small outdoor jobs, this convenient package eliminates wastes and cuts costs. Available in sizes 4 to 14 AWG, soft and medium hard.

RoMarine-RoPrene—Type USE, Style RR

This economical and all-resistant power cable can be a sales leader. Neoprene sheathed, it resists acids, oils, moisture and flame. Ideal for industrials, utilities, residential and farm jobs, airport lighting and outdoor theaters. Underwriters' approved as Type USE for underground services.

Why it Pays to Sell Rome Cable Products

Rome Cable recognizes the electrical wholesaler as the logical distributor of its products and has always maintained a strict wholesaler policy.

Rome Cable advertises aggressively on a national scale. Its products are well known.

Rome Cable service is dependable with well stocked warehouses strategically located.

ROME CABLE Corporation
ROME • NEW YORK
From Bar to Finished Wire

ROME CABLE ROME, N.Y.

Complete SIGNALING SYSTEMS

AUTH

FROM *One* RESPONSIBLE SOURCE

Whether it's a hospital or a school, a housing project or an industrial plant, Auth makes the signaling systems for it — complete! Protect *your* reputation by installing reputable systems . . . Eliminate confusion . . . simplify your work . . . and save money.

On your next job place the responsibility for all signaling and communication equipment with Auth, a Company having more than half a century of experience in this field. You'll be glad you did.

FOR HOUSING
U. S. Approved Mail Boxes; Doorbell Systems and Mechanical Door Chimes; Telephone and Fire Alarm Systems.

FOR HOSPITAL
Nurses' Call, Doctors' Paging, and "In and Out" Register Systems; Clock, Telephone, and Fire Alarm Systems; Night Lights.

FOR SCHOOLS
Clock, Program Bell, and Fire Alarm Systems; Telephone and Miscellaneous Signaling Systems.

FOR OFFICES
Buzzer, Annunciator, and Clock Systems; Telephone, Fire Alarm, and Elevator Signaling Systems.

FOR INDUSTRIAL PLANTS
Fire Alarm, Telephone, and Paging Systems; Clock and Program Bell Systems. Supervisory Annunciators.

FOR COMMERCIAL HOUSES
Telephone, Clock, and Fire Alarm Systems; Buzzer, Annunciator, and Paging Systems.

Descriptive Literature upon Request

Sales Representatives in Principal Cities

Complete Systems • One Responsibility

AUTH ELECTRIC COMPANY, INC.

34-20 45TH ST., LONG ISLAND CITY 1, NEW YORK

MANUFACTURERS OF
Electrical Signaling, Communications, and Protective Equipment for Housing, Hospitals, Schools, Offices, Ships and Industry.

SINCE 1892
AUTH

3 BIG "EXTRAS" ADDING UP TO—

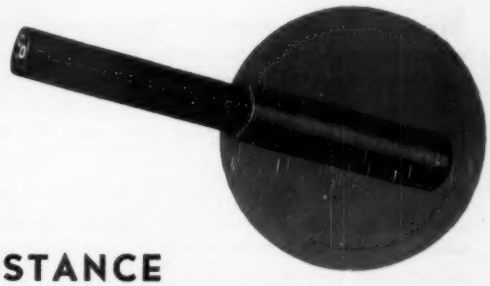
EXTRA-LONG SERVICE FROM SIMPLEX-TIREX PORTABLE CORDS...

SELENIUM NEOPRENE ARMOR

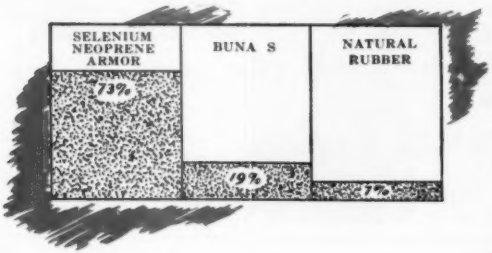
All TIREX Portable Cords are jacketed with the exclusive Selenium Neoprene Armor — not "just another" neoprene jacket but, rather, another product of skilled Simplex research, carefully manufactured to provide unfailing protection against rough handling, oil, grease, chemicals, heat, sunlight and flame. And tough though it is, Selenium Neoprene Armor is also highly flexible. Your TIREX Cords will not snarl or kink.

CURED-IN-LEAD

All TIREX Cords are Cured-in-lead; vulcanized while enclosed in a snug-fitting lead "pipe". When vulcanization is completed the lead is stripped off leaving an extra-tough jacket that will stand up under crushing and twisting, dragging over rough surfaces, and pulling around sharp bends. Curing-in-Lead assures a smooth jacket surface and uniform diameter, and it provides the means for molding onto the jacket such identifying data as size, type, number of conductors, and operating voltage.



OIL RESISTANCE



Selenium Neoprene Armor is unusually oil resistant. Tested after 7 days' immersion in SAE-30 machine oil at 150 F. it retained 73% of its original tensile strength. Buna-S rubber jackets retained only 19%, while natural rubber jackets fell to 7%. This testing is exceptionally severe but it is your assurance that Simplex-TIREX Cords will stay on the job under continual exposure to oils and grease, a condition that prevails in nearly all industrial applications.

SIMPLEX

WIRES AND CABLES

SIMPLEX WIRE & CABLE CO.

79 Sidney St., Cambridge 39, Massachusetts

MAIL THIS COUPON FOR COMPLETE DETAILS

SIMPLEX WIRE & CABLE CO.
79 SIDNEY ST., CAMBRIDGE 39, MASS.
GENTLEMEN: PLEASE SEND CATALOG 992 TO:
NAME _____ TITLE _____
COMPANY _____
STREET _____
CITY _____ STATE _____

Main and Range "Plus"

Cat. No. 663-104—parallel hook-up
Cat. No. 663-204—series hook-up
Available Surface or Flush

Another Addition to

General's Line of Pullout Combinations

HERE is the latest product of General engineering—*another* new triple pullout combination specially designed to save the contractor time and trouble on installations requiring both a main and range combination and an *additional* switch for clothes dryer, water heater, pump or any other 220V, 30 or 60 Amp. circuit.

Available with either series or parallel connection, the new units are adaptable to many wiring requirements—special internal construction permits individual wiring of the lower pullout switch where separate metering is required—the series unit may be energized through its subfeed lugs from General's 100 Amp. fusible main pullout switch, thereby making the three pullouts available as individual branch switches. The parallel connected unit has 100 Amp. main lugs.

The next time ask for the new Main and Range "*Plus*" and learn why "*The Switch is to* General".

Write for latest Catalog 4809 and Supplement 4911.

Sold exclusively through wholesalers.

General
Cat. No. 666-108
Triple pullout combination with *eight* plug fused branch circuits.

General
Cat. No. 1100
100 Amp. fusible pullout suitable for use as service entrance or branch switch.

General Switch Corp.
49 Roebling Street Brooklyn 11, N. Y.

One of the leading Manufacturers of:

SERVICE EQUIPMENT . . .
Pullout, Front Operated Toggle and Side Operated types. Indoor—surface or flush, and Outdoor.

SAFETY SWITCHES . . .
30 through 1200 Amp., 250 V and 600 V Type A, C and D. Indoor and outdoor. HP rated.

ELECTRICAL DISTRIBUTION EQUIPMENT

SALES OFFICES IN EVERY MAJOR CITY

which do you want?

we make them all

Yes, Spang makes them all. No matter what type of rigid conduit is called for on the job, you can get it from your friendly Central Conduit Distributor.

He handles three types of full weight, rigid steel conduit: "CENLACO" has a hot dipped, galvanized finish both inside and out . . . "CENTRAL WHITE" has an electro-galvanized finish on the outside and black enameled on the inside . . . "CENTRAL BLACK" has a black enameled finish both inside and out. And he handles "CENTRAL EMT", a *light-weight* steel conduit that's electro-galvanized on the outside and durably lacquered on the inside. All of them are manufactured to Spang's quality specifications. And all of them meet Underwriters' Laboratories requirements and are approved by the National Electrical Code.

Your friendly Central Conduit Distributor also handles complete lines of other electrical products. And when you call him, you'll learn why he takes such pride in the service that he gives to his customers.

SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICE: GRANT BLDG., PITTSBURGH, PA.

District Offices and Sales Representatives in Principal Cities

CENLACO a hot dipped galvanized and lacquered finish, inside and out.

CENTRAL WHITE electro-galvanized outside and black enameled inside.

CENTRAL BLACK permanent, baked-on black enamel finish, inside and out.

EMT—Light-weight electro-galvanized outside and durably lacquered inside.

How to pull more watts through old pipes with

Where you must crowd large quantities of wiring into small space. U·S·S Ampyrol small diameter wire requires only about half the space needed for rubber covered wire of equal current carrying capacity.

Where you must increase the capacity of your lines without tearing up the conduit. Old wiring can often be replaced with Ampyrol lines of 50% to 100% greater capacity. The smooth, wax-like surface of Ampyrol makes it easy to pull through conduit.

Where moisture and mildew are a problem. Ampyrol does not absorb moisture —is unaffected by mildew.

U·S·S Ampyrol

plastic insulated wire saves money— *gives better service!*

● U·S·S Ampyrol is one of those developments that seems too good to be true. Not only is it a money-saver for rewiring jobs, but Ampyrol's unusual properties put it in a class by itself when it comes to *new* and original equipment installations.

About rewiring. Ampyrol pays for itself, a dozen times over, when line capacity must be increased. For capacity can often be doubled, *without tearing up existing conduit.* The savings in rip-out costs *alone* are usually enough to pay for the entire rewiring job.

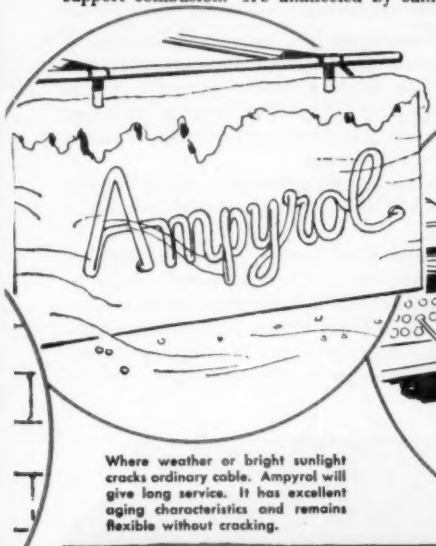
And it's not difficult to do. Because the smooth, wax-like surface makes Ampyrol easy to snake. Electrical contractors state that they have more trouble removing the old wire than they do installing Ampyrol.

Acids and alkalies don't bother Ampyrol. Neither do ozone and many commercial solvents. Ampyrol does not support combusion. It's unaffected by sunlight, oil and water. It has excellent aging qualities and *remains* flexible without cracking.

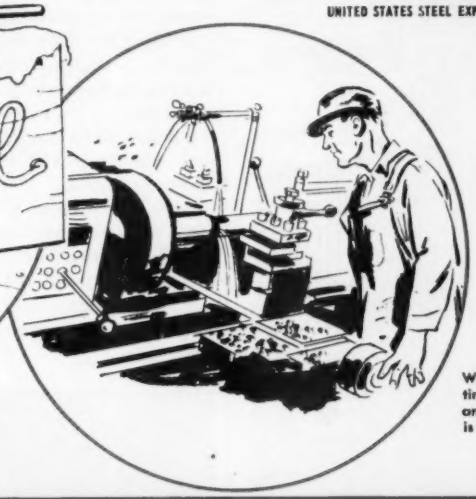
Ampyrol is available in 12 permanent colors that won't wear off. You can use it for some of the most complex coded wiring and be sure your wiring is *permanently* coded.

How is Ampyrol different from other plastic wire? It's all in the way we make it. The American Steel & Wire Company has developed special techniques and machinery that means a better, more uniform product. Write for complete information on types and sizes available.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK



Where weather or bright sunlight cracks ordinary cable. Ampyrol will give long service. It has excellent aging characteristics and remains flexible without cracking.



Where wiring gets splashed with cutting oils, acids, alkalis, grease and coolants. No damage results for Ampyrol is impervious to all these agents.

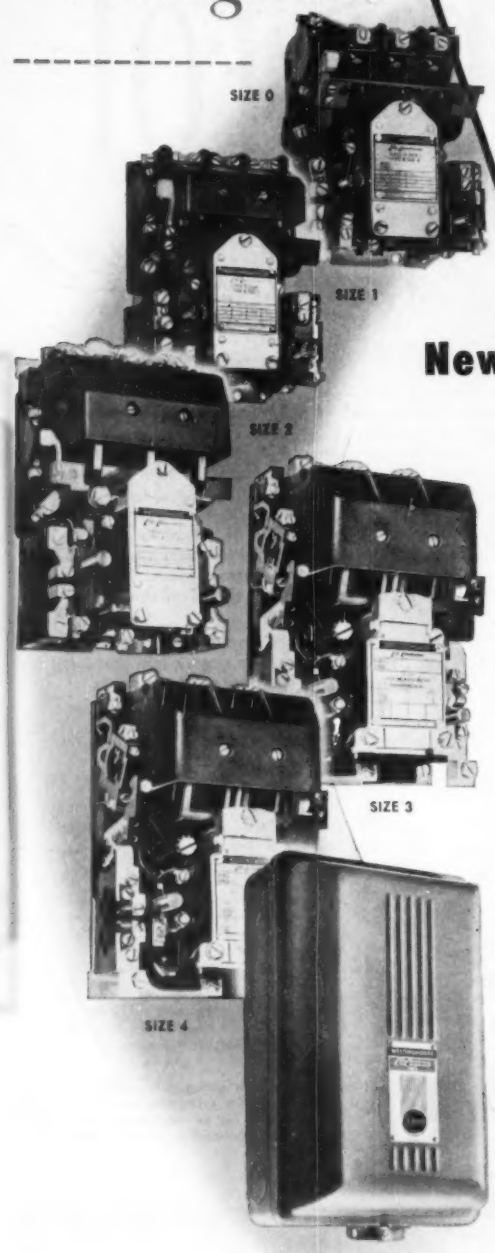
USS Ampyrol Wire and Cable

UNITED STATES STEEL

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

IT'S NEW! COMPLETE! UNIFORM!



*Life-Linestarter**

New Dollar-saving Teammate for A-C Motors

- **for production-conscious users** of motor control
- **for cost-conscious executives** looking for ways to reduce operating expenditures and inventories
- **for machinery manufacturers,** who want to offer maximum continuity and ease of service to their customers . . .

  plus initial savings in starter installation

  plus greater machine salability resulting from compact size, uniform wiring, simplified construction

The new Life-Linestarter is a major advancement in motor control. It's the culmination of 40 years' experience and more than six years of laboratory tests and field trials . . . thoroughly field-proved through wide use under actual operating conditions. It offers more starter per dollar . . . on every count.

Life-Linestarters are best because they offer uniformity and completeness of line . . . uniformity of appearance and construction.

Also check these other features—superior performance, positive operation, ease of installation—found in detail in Booklet B-4677. Ask your Westinghouse salesman for a copy of a Trans-Vision presentation of the new Life-Linestarter. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30020

**Trade Mark*

Westinghouse

Life-Linestarter

TOMORROW'S STARTER—TODAY!

JULY . . . . *at a Glance*

Profitable Work

Extraordinary care in figuring and bidding on competitive work, particularly the class of work that attracts long lists of bidders cannot be too strongly urged at this time.

The stiffening of prices which we warned about in February (E.C.&M. Page 47) of this year is already noticeable and some prices are up. While on the whole no radical price movements are in immediate prospect, any bets that they will move downward this year are strictly long shots.

During the first quarter a lot of work was contracted for at incredibly thin margins, work that will tie up organizations, personnel and key mechanics for months ahead with little prospect of doing any better than breaking even.

A glance at some of the longer bidding lists discloses a highly significant phenomenon. A good number of well managed and soundly established firms are missing. And they still seem to be doing business.

The present volume of electrical construction work is running at an all time high. If war comes again, or even if the cold war intensifies the production, capacity of the industry will be taxed to the breaking point. It is our guess that a good many of the experienced and wiser heads in the industry are deliberately passing up the bidding contests. This is clearly no time to load up the shop with a great volume of cheap work.

Modernization

What is the alternative to battling it out on the price line around the new brick piles? In every town and city there are buildings and factories of uncertain age and practically certain electrical obsolescence. Their wiring is overloaded, inadequate and probably dangerous. Their owners need expert counsel and conscientious help. And the work has to be done by efficient modern methods at a reasonable price.

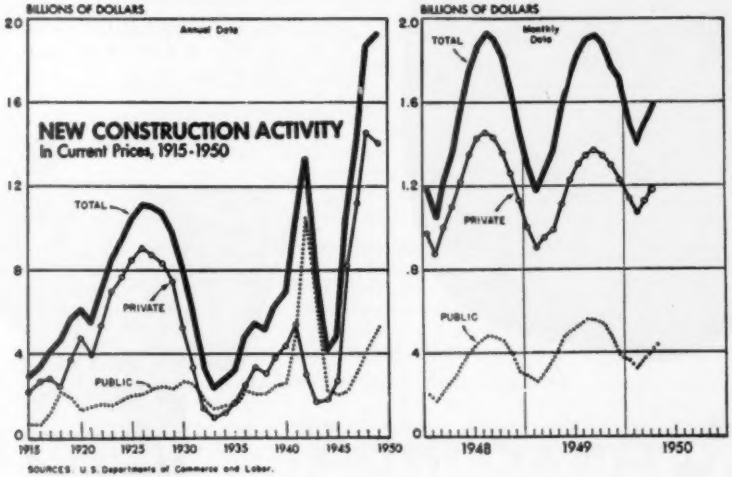
Such jobs are not advertised for bids. The owners may not even know their wiring is obsolete or dangerous. They have to be told. And they have to be sold electrical modernization.

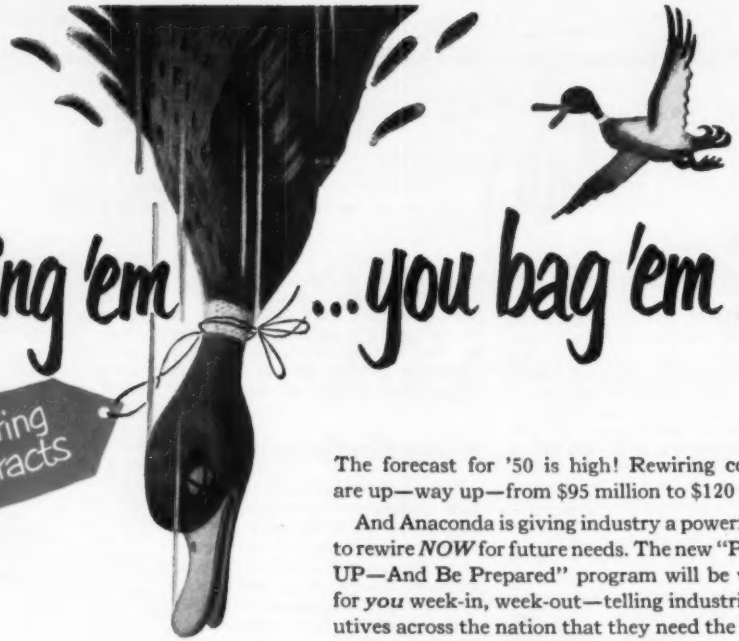
In this kind of work there are opportunities well above the battle of the bids. With effective sales effort, price is rarely a decisive factor.

To this market, its opportunities and its methods, we have devoted a special editorial feature section this month. In the 36 pages we have packed in as much directly useful and easily absorbed material as we could. Every member of the staff has had a hand in the job and has contributed importantly to it. We hope you will find it a practical data source for meeting the problems of electrical modernization work. And if, along the line somewhere we have not covered some feature as well as we should, tell us. It will help to guide us in the preparation of further articles relating to this tremendous market opportunity.

NISA

Several of our staff found time to join with the motor shop folks at their annual meeting in Boston last month. It was a big meeting, well attended and, as usual, well programmed, with plenty of time for practical shop problem discussion. Our cameras were busy and our noteboks caught as much as possible of the essence of the sessions. The story is on page 179.





We wing 'em ...you bag 'em!

The forecast for '50 is high! Rewiring contracts are up—way up—from $95 million to $120 million!

And Anaconda is giving industry a powerful push to rewire *NOW* for future needs. The new "POWER UP—And Be Prepared" program will be working for *you* week-in, week-out—telling industrial executives across the nation that they need the benefits of complete electrical modernization.

Tie in with this all-out Anaconda drive. Ask your Anaconda wholesaler for your free "Contractor Sales Kit," today! In it you'll find your own copy of "POWER UP—And Be Prepared," a complete guide to wiring systems and their maintenance . . . direct mail pieces, booklets, letters, sales helps . . . all the ammunition you need wrapped up in one neat package.

Call your industrial customers now. Arrange to give their plants an over-all electrical check-up. Help them to "POWER UP—And Be Prepared!" Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

This symbol means business for YOU in Anaconda's new Wiring Modernization campaign directed to all industry using electric power.

The right cable for the job **ANACONDA®**

WIRE AND CABLE

ELECTRICAL CONSTRUCTION AND MAINTENANCE

49th Year — JULY • 1950

Growth Potential

TOTAL NATIONAL OUTPUT in 10 years will be up 18 percent to $315 billion. Population will be up to 165 million and employment 65.5 million. Business capital expenditures will be close to $25 billion as compared with $20 billion in 1950, and consumer expenditures will go to $220 billion as compared with this year's $185 billion.

THIS IS THE POTENTIAL about which economists are in fairly close agreement. It is not a forecast. Our economy rises and falls, sometimes moderately, sometimes violently, but balances out around a steadily rising line. Carried forward 10 years, that line gives the figures above.

FOR ELECTRICAL CONSTRUCTION WORK, the general economic trend is not enough. This is a growth industry with outstanding growth potential. For instance, electric power use is expected to just about double in 10 years. The electrical industry has consistently grown faster than the total economy. And there is nothing in the outlook to indicate that it will not continue to do so.

MOST BUSINESS DECISIONS are made upon the data of the moment. This month's balance sheet will influence plans and policies which may have to extend through entirely different business conditions. And certainly close knowledge of current conditions, immediate trends and opportunities are of utmost importance in operating a business.

BUT MANY GOOD ELECTRICAL FIRMS have a long history and many will have a longer future. They have operated through boom and depression, through shortage and surplus, and, with good management, will continue to do so. They, and their operation, will be a part of, and, in fact, essential to, the great growth potential of this industry.

THE LONG FORWARD LOOK is a necessary consideration in the plans and policies of such companies, particularly as they affect the basic structure of the organization. What of plans for office space, warehousing, shop facilities, tools and equipment? How about capital, banking connections and fiscal policy? What about executive and staff personnel, and apprentice training? These are matters much better related to a deliberate projected outlook along the economic trend lines than to decisions made solely on the tides of the moment.

SUCH PLANNING NEED NOT BE NEBULOUS. It can be highly specific and practical. Most prudent folks plan for the advanced education of their children before they reach their teens. They also insure against hazards and death when there is a strong statistical probability that such events are many years away. And, according to the economists, long term economics is just as predictable.

MANAGEMENT AND MEN make the growth potential of the electrical industry. In our society, each has a very wide area of choice as to just how big a factor he will be. However he may appraise the trends of the moment, he ignores the industry's growth potential at his own peril.

William H. Stuart

IT'S ALWAYS RIGHT

and right on schedule

. . . with wiring materials via Graybar

You're sure every item on your wiring materials and supply order will be right for the job—and will be delivered right on schedule—when you order via Graybar. You know all the items will fit together properly. You know there'll be no waiting for conduit to come from one supplier . . . boxes and fittings from another . . . wire from a third. And your order gets an important "plus" of personal interest, for Graybar is wholly owned by its operating and retired personnel. From the man who takes your order to the one who packs it, we're anxious to serve you well.

EXPERT HELP WHEN YOU NEED IT

To help you or your customers in planning complicated systems or solving difficult wiring problems, a Graybar Inside Construction Specialist is available. His recommendations, supplementing the knowledge of your local Graybar Representative about materials and delivery, will help keep your wiring jobs moving "right on schedule".

One order for everything

With a single order to Graybar, you can obtain everything for any wiring job . . . big or small . . . indoors or out. Graybar distributes 100,000 electrical products of more than 200 manufacturers—carefully selected materials, supplies, equipment, and tools for wiring, lighting, communication, power, and all your other electrical needs. Quick delivery of many items from local Graybar stocks often helps to avoid work delays.

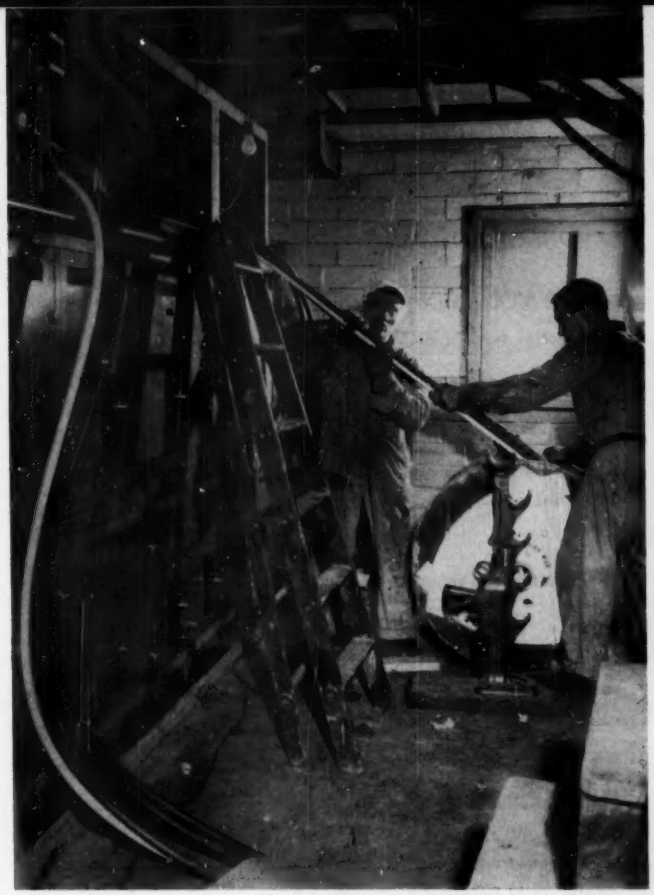
Free samples of tape

So that you can test them for yourself on your wiring jobs, we'd like to send you descriptive folders and free samples of "Scotch" Electrical Tape No. 27 and "Scotch" No. 33 Electrical Tape—plus a free sample of Sticka friction tape. To get yours, just write *Dept. 5071, Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y.*

You get the best of everything electrical

Via GraybaR

- Markets for Electrical Modernization
- Basic Considerations In Modernization
- Service Entrances
- Distribution Systems
- Power Circuits
- Motors and Control
- Branch Circuit Wiring
- Lighting Modernization
- Estimating Electrical Modernization Work



ELECTRICAL MODERNIZATION

ELECTRICAL modernization is big business. About one quarter of some 2.2 billions of dollars of this year's electrical construction (and maybe more since good statistics in the field are rare), comes under the general classification.

Some jobs are small, a few additional outlets, an added circuit or two. Some are very large. A case study on page 96 describes one totaling many hundreds of thousands of dollars. And all along the scale between, modernization represents a vitally important part of the work of practically every electrical contractor in the land.

The methods and practices of electrical modernization are infinitely varied. Each job is a challenge to management, to our industry's skill and ingenuity. Effective work requires also an exceptional knowledge of available materials and tools and their special uses.

In the following pages we are presenting the proceeds of months of effort by our editorial staff to bring together useful experience data of practical use in estimating, planning and executing electrical modernization work. The material has been arranged systematically and presented largely by photos, diagrams and drawings.

Much of the material will be found useful not only for its practical know-how, but as a source of ideas for selling effort.

Market potentials in modernization are ripe for creative selling. The National Electrical Contractors Association is making available to its members strong promotional helps for tackling this market. A number of prominent electrical manufacturers have prepared useful sales material, particularly in the field of lighting modernization.

The field of electrical modernization presents a challenging market that deserves concerted industry attention. There's room enough for the best efforts of all.

ESTIMATED ELECTRICAL CONSTRUCTION 1949–1950

Type of Construction	Millions of Dollars 1949	1950
PRIVATE—NEW WORK		
Residential (non-farm)	560	616
Farm	36	47
Industrial	140	100
Warehouse, office and loft	30	
Stores, restaurants, garages	84	232
Misc. non-residential	108	
Railroads	23	21
Telephone and telegraph	52	45
Utilities	240	240
Total Private	1,273	1,301
PUBLIC—NEW WORK		
Residential	15	35
Educational	84	105
Hospital and institutional	45	65
Other non-residential	35	40
Military and naval	6	5
Highway	49	57
Sewer and water	28	32
Misc. public service	5	5
Conservation and development	40	45
All other public	9	11
Total Public	316	400
Total New Construction	1,589	1,701
MODERNIZATION AND REPAIR		
Service replacement	70	85
Appliance circuits	60	65
Rewiring	95	120
Relighting	160	190
Repairs and miscellaneous	50	50
Total Modernization and Repair	435	510
Total All	2,024	2,211

MARKETS FOR

The market for electrical modernization is the most widespread both geographically and in scope of work of any segment of potential electrical business. Electrical modernization needs occur at every crossroad, in every town and city. And needs can vary from a small service capacity increase to a major rewiring job in a metropolitan skyscraper.

The background of this ever-growing potential market lies in the steady steep rise in the use of electricity, a gain of roughly 10 percent per year. No parallel increase in installed wiring capacity in existing buildings has followed utilization. And there is no evidence that demand growth will decline in the foreseeable future. Each year more and more buildings are becoming electrically obsolete, unable to adopt further electrical equipment without a major rewiring operation.

Obsolescence

As a practical matter, any building wired more than 15 years ago is electrically obsolete by modern standards. Optimum lighting intensities have tripled. Power requirements are up substantially. Electric heat, air conditioning, water heating and cooling are growing at a rate far beyond the expectations of the prewar era.

Wiring more than 30 years old requires replacement on safety conditions alone. Wiring installed during war years was under severe restrictions. Much of it needs replacement or expansion.

During the last two years capital investment in industry has shown a decided shift from new plant expansion to existing plant modernization, which will include extensive electrical work. The field of electrical modernization today presents the most important area for creative market development confronting the electrical industry.

In the accompanying estimate of electrical construction volume, originally projected in January and revised as of June 1, it will be noted that modernization and repair account for about one quarter of the total. This is a conservative percentage. Other studies have placed the percentage in the order of one third. In any case, it is generally conceded that electrical modernization and repair is an ascending curve in both dollar volume and as a percentage of total electrical construction business.

Long Range

On the longer range, some idea of the market potential can be derived from the projection of the electric power industry. Industrial power sales are expected to rise 60 percent and residential sales to double by 1960.

While manpower is becoming more expensive, electric power promises to grow steadily cheaper. Power generation requires little labor and the cost per unit decreases substantially as volume multiplies. Electricity will be one of the great bargains of the 50s.

Those industries due for the fastest growth are among the greatest users of power—for example, the chemical process industries. And throughout all industry, the amount of power per unit of production is growing. In 1950, industry is using about 1.5 billion kilowatt-hours for every point of production on the FRB index. But by 1960, the ratio will probably be more than 2.3 billion kwh.

Even more sensational gains are looked for in resi-

dential use of electricity. The increasing electrification of the home—notably the farm home—promises to be as important in the next decade as was the original electrification of industry in the 1920s. Power use per residential customer is expected nearly to double by 1960.

American homes still offer a great unsatisfied market for new kinds of electric appliances. Less than 10% of our households have electric dishwashers, food disposal units, clothes dryers or bed coverings. Less than 20% have TV sets. Electric heating and air conditioning, still rare in home use, are pointing for big markets in the years ahead. To exploit fully the opportunities opening up for electric appliances will require aggressive merchandising. They compete with many other products for the consumer's dollar. But even a conservative estimate makes the outlook bright.

If we compare such projections with probable new construction, expected to rise about 25 percent through the decade, it is apparent that new buildings can absorb only a fraction of the projected increase in electrical utilization. The rest must flow through service entrances, feeders and wiring systems in existing buildings, most of which are already inadequate for today's requirements.

Electric power sales may or may not achieve industry projections. If they do not, however, a 50 year trend line will be broken. Most observers feel that the above projections are substantially conservative.

What this means in electrical modernization requirements is that each year an increasing number of buildings will reach the point where rewiring becomes essential.

How to Line Up Prospects

Electrical modernization work is often a by-product of minor repairs. The importance of prompt, efficient handling of trouble calls cannot be overemphasized. They open the way for wiring system surveys and modernization recommendations.

New lighting installations open up opportunities for extensive rewiring. Modern lighting systems are rarely adaptable to existing wiring. And the needed wiring can be logically developed to complete electrical modernization.

Appliance or machinery installation often requires added circuits and additional system capacity, a good opening for extensive improvements in the wiring system.

Frequent moving and changes in industrial machinery layouts present a good opening for developing bus systems, networks or other highly flexible power system installations.

There is also plenty of room for direct sales effort on selected prospect lists. Practically any building more than thirty years old is certain to need extensive electrical modernization.

Survey the Job

Original wiring plans, if available, are the most useful starting point. A complete layout should be made noting all existing loads and immediate requirements. Before it is completed, however, a conference should be set up with the owners to project probable wiring requirements at least a few years into the future.

In an industrial plant, company records of electrical utilization growth are useful data for projecting probable future needs. In stores and offices, most building managements are aware of the very large increases in lighting and other electrical requirements. It is a practical certainty that further growth at substantially the same rate is in prospect during the next one or two decades, in anything like a normal economy.

Economic reports of individual industry growth, such as chemical, food, textile, can be gleamed from libraries to help support projections of probable electrical needs and application possibilities.

How to Present a Proposal

Many good modernization prospects are lost through ineffective sales work. Too often the entire project is presented in nothing but a price quotation.

Every step in the preparation of a proposal can be a useful and effective part of the proposal. Survey data, sketches, plans, take-off and estimating sheets demonstrate the complexity of the work. They can be copies and inserted in a neat binder or folder. Photographs of similar work demonstrate experience, skill and equipment. A well written description of the work to be done and the effects to be accomplished is essential. With such preparation, the price quotation is subordinated to a host of specific customer benefits.

Estimating

Specific considerations for estimating electrical modernization work is presented in another part of this editorial feature section. In relation to market development, however, some observations are pertinent here.

Most modernization work should be negotiated on other than a lump sum basis. Work in existing buildings is almost never predictable with precision. There are many cost risks involved. The prudent estimator must allow for the worst conditions likely to be encountered. Such allowances are not in the customer's interest but essential to safe estimating.

The cost risks of electrical modernization work are largely introduced by the nature of the customer's premises. In all fairness, they should not be borne by the contractor. Further, the opposition of interest inherent in the lump sum contract impedes the cooperation between contractor and owner essential to effective and economical execution of the work.

Housing

While the emphasis of this editorial feature is on commercial, institutional and industrial work, the very great market potential in residences should not be overlooked. Most effective forces today in the development of residential rewiring are major appliance sales.

Ranges, water heaters, electric heaters, air conditioners and clothes dryers are among the high wattage loads which almost invariably require extensive service and wiring changes. In most areas, however, the additional wiring is only enough to handle the immediate needs of the device installed.

When such installations are planned, there is a good opportunity to project the probable requirements over a few years and provide additional service and panelboard capacity.

TIME AND ENERGY are obtained by remote controls, permitting operators to start, stop or slow machine action from a convenient position.

SAFETY through the use of explosion-proof junction boxes, deion breakers, watthour meters and across-the-line starters, such as this equipment used in a refinery, is another objective of modernization in both existing plants and buildings under design or construction.

BASIC CONSIDERATIONS

Why Modernize?

Over 90 percent of our industrial plants, commercial establishments, homes and farms are wired inadequately: testimony to the ever-growing utilization of electricity for power, lighting and heat. The present need for modernization, therefore, is indicative of healthy electrical expansion, because distribution systems installed a decade or more back would not now be overloaded if it were not for new concepts of high-level illumination, electric heating, refrigeration, more extensive motorization and control.

Modernization calls for heavier feeders, new switchgear, greater distribution flexibility and more versatile operational methods. Modernization offers six advantages to the plant or building owner as well.

Objectives

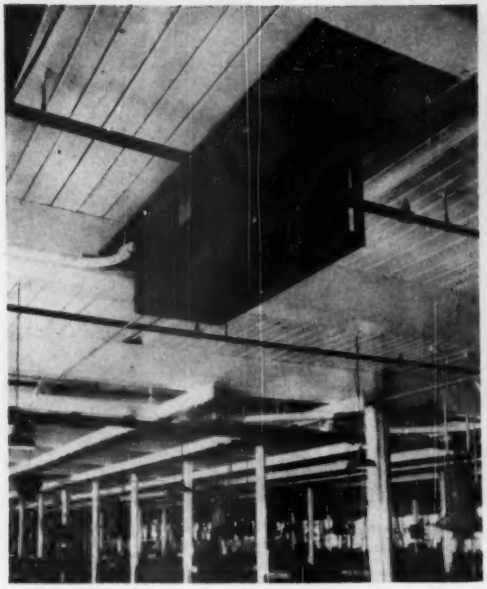
1. Essential addition to provide power to new equipment and apparatus incident to their installation.
2. Addition and alterations to provide for flexibility, ample capacity and ready accessibility for equipment and apparatus to be installed.
3. Provisions for electrical facilities which simplify the application of modern methods and equipment.
4. Provision for electrical facilities which permit application of modern standards of illumination and air conditioning.
5. Enhanced capacity and accessibility to reduce losses and improve electrical system operation efficiency.
6. Replacement of obsolete, worn, damaged or potentially dangerous wiring, equipment and apparatus.

Dependability is another resultant of modernization. Motors are a case in point, for modern practices such as the use of silicone varnishes, fiberglas insulation, plastic coatings for windings and dynamic balancing of rotating elements are establishing new service records for motors operating under severe conditions. Underground wiring is another modern practice promoting circuit dependability, for the damage from heavy snow and ice is minimized and falling or moving objects cannot disrupt the service.

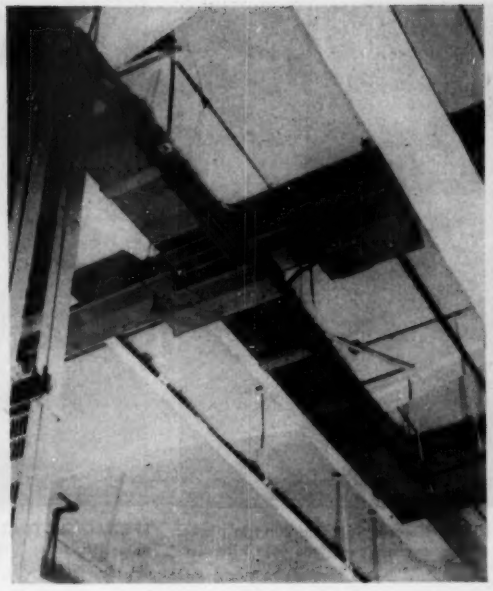
Safety cannot be ignored, and self-evident examples are observed in dead-front switchgear, control interlocks, color coding of equipment, the installation of explosion-proof equipment in hazardous locations and the replacement of defective or badly worn power tools.

The final point to be mentioned in connection with modernization is *comfort*, a contributory factor in higher production, better personnel relations, improved health and operating proficiency.

These objectives answer the question, "Why Modernize?". They also constitute useful selling tools. Customers don't buy electrical wiring for the sake of ownership; their interest lies in the end results, the advantages to be gained. Selling heavier feeders, new switchgear, communication systems, ductwork or heating equipment—however necessary—suggests to the potential buyer one main limitation: expense. Yet talking about modernization in terms of the immediate and long range benefits will interpret the electrical modernization work in terms of his own needs. When the service or need is thoroughly appreciated, cost becomes a secondary consideration.



EFFICIENCY in the form of improved power factor can be obtained through the use of capacitor equipment similar to this ceiling-mounted small-rack 120-kvar unit installed in a yarn spinning mill.



FLEXIBILITY and convenience is the result of using bus-duct for carrying power to load centers and utilization points. Sections are easily handled, can be reused, place power where it is needed.

Analysis

Modernization *must* have an objective, otherwise it is unjustified. And objectives can be determined only through analysis of conditions as they exist and conditions to be desired. This logically involves plant surveys, all of which relate to the six objectives just discussed. Here are a few questions to determine the necessity for plant modernization:

Are there sufficient power outlets for possible layout changes?

Have load centers shifted since the distribution system was originally installed?

Is continuity of operation insured by present external and internal distribution feeders and switchgear?

Are there sufficient spare motors and essential parts in stock to minimize shutdown times in case of emergency, or to permit sudden expansion of plant facilities?

Could extra space be used if unit heaters or cooling equipment was installed?

Would changes in control improve operational flexibility?

What is the total load of the plant, and how can power factor be improved?

Is voltage maintained at all points of utilization?

Are present feeders adequate and properly located through load centers, or would improvements in the distribution system (such as the installation of bus-duct) aid plant operation?

Are conveyors and electric trucks used to their fullest capacities?

Are there sufficient outlets for hand tools?

What problems exist due to unusual temperature conditions, the presence of abnormal humidity or excessive dust?

Are machines located properly for efficient materials handling between operations or for maximum facility in distribution and control of current?

Are motors the correct sizes for the jobs at hand, can automatic feed be installed, or can machine speeds be safely or advantageously increased?

Will limit switches speed the work, and can electric hoists be used?

Is material delivered at the proper height, and can one operator attend more than a single machine with safety?

Can induction or radiant heating be used to advantage?

How about the use of infra-red lamps?

Every plant will have different local conditions, different problems and different solutions. Honest self-analysis will bring these problems to light, and planned modernization will pay dividends in the forms of achieved economy, efficiency, dependability and safety.

Measuring Instruments

Surveys demand exact circuit data and specific operating facts, obtained through the use of electrical measuring instruments. In fact, instruments are the stethoscopes by which we measure the heart beats of a system. And, by diagnosing existing conditions and analyzing the data obtained, steps can be taken to reduce current waste and increase plant efficiency through planned modernization.

Basic instruments include ammeters, voltmeters and wattmeters of sufficient range to measure the smallest and largest quantities of current, voltage and power handled by the system; also megohmmeters for measuring insulation resistance. Split-core clamp-on instruments have as many applications as boxed units. And small measuring instruments, such as lightmeters and tachometers, are also valuable aids in compiling exact data for surveys.

CUTTING, chipping or drilling in plaster or masonry walls is made easy with electric hammers.

SPECIAL CUTTING jobs can be handled most effectively with special accessories for standard tools.

DRILLING STEEL for installation of switch box is a tough job which can be performed with electric impact tool.

Cutting and Patching

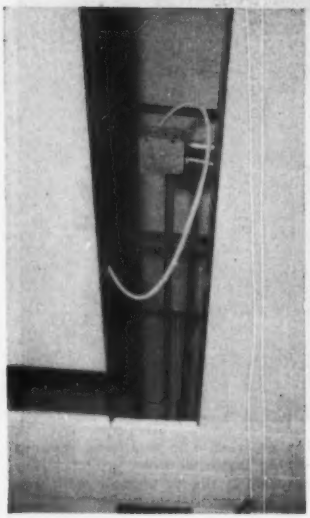
A good analysis of the existing electrical work on any structure will embrace the location of all outlets, conduit runs, and circuit arrangements between these outlets and in the conduits. Thus, when new circuits are to be run, it is an easy job to identify the areas for cutting, and to mark them with crayon. Electric detectors can be used advantageously for marking out areas to be cut, as they will aid in locating hidden metal outlet boxes, steel conduit and armored cable in walls, floors and ceilings.

Drilling, cutting and chipping of concrete, masonry and other building materials will often provide shortcuts for new runs of conduit, or armored cable. This work can be done economically and fast with almost any of the good electric hammers now available. In considering drilling or chipping, it should also be kept in mind that the same areas will have to be patched up with mortar or plaster and refinished to look like new. Cost of the patching and refinishing work, therefore, should be added to the cutting and drilling costs when considering this type of work.

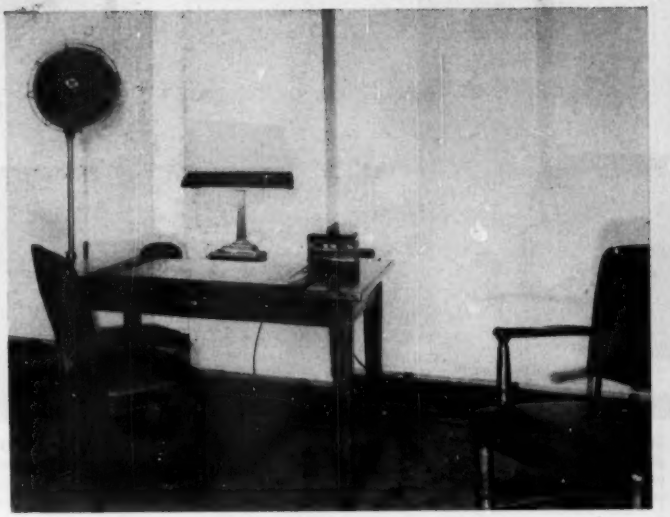
The success in keeping cutting, drilling, chipping, and patching costs at a minimum, and thereby making it practical to do such work in most cases where it is indicated,

RECESSED LIGHTING equipment requires cutting of ceiling to fit lighting units, but permits circuit extensions to be run exposed in area over suspended ceiling.

CIRCUIT EXTENSIONS can be run concealed in flexible cable which will bury in plaster work. Cutting and patching of plaster is a minor operation.



GRID SYSTEM of wiring, with outlets spaced ten feet apart over ceiling, provides branch circuit for recessed fixtures.



ELECTRICAL OUTLETS are provided inconspicuously in steel raceway which can be installed exposed on top of the baseboard. When painted to match the trim, plug-in strips blend with decorative treatments.

lies in the use of the many standard and special cutting and drilling tools which have been developed for this purpose. Such tools speed up this work and save much time on the toughest jobs. Time saved means lower costs, a most important factor on each job.

Exposed Work

Every electrical modernization job must of necessity be individually analyzed. No two jobs are likely to have the same conditions and problems. Analysis will often show economies in discarding all of the old electrical work, and installing a new, well designed, flexible and adequate electrical system. This is often the case when building remodeling or building construction changes are also involved.

There are many modernization jobs, however, that are limited to the installation of new convenience outlets, or to the extension of branch circuits to provide outlets near the point of utilization. Such jobs can be handled adequately and effectively with surface raceway and fittings run exposed on the ceiling or on wall surfaces. This type of job eliminates the cutting of plaster and masonry and permits jobs to be done at lower costs.

In industrial plant modernization, it is also usually advantageous (and permissible from an appearance standpoint) to run conduit or EMT exposed. New outlets can be installed economically for either light or power, on the ceiling, on walls, or on columns. Conduits and outlets can be strapped to steel trusses or columns, or to beams and other places of support. Where conduits must be bent, in such cases, care should be taken to keep bends uniform.

Using Structural Features

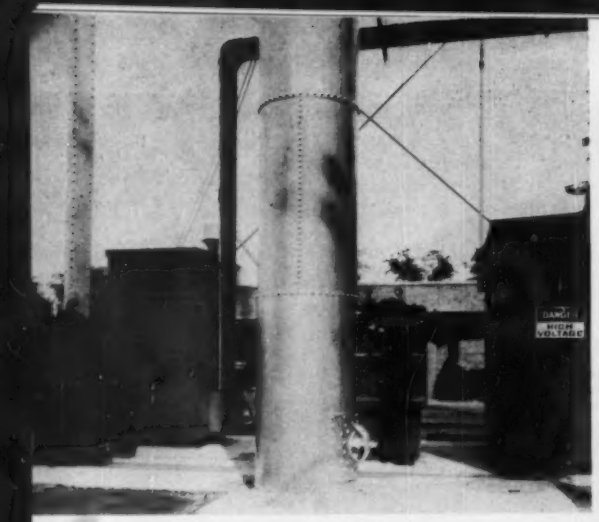
The electric distribution system within any building is usually concealed, except in industrial or open type construction plants or buildings. For this reason, the space requirements needed for electrical wiring systems are often overlooked, or at least minimized. It is important, therefore, on either new or remodelling work that plans

INFLUENCE OF WIRING CAPACITY ON LIGHTING INTENSITIES FOR TYPICAL LUMINAIRES

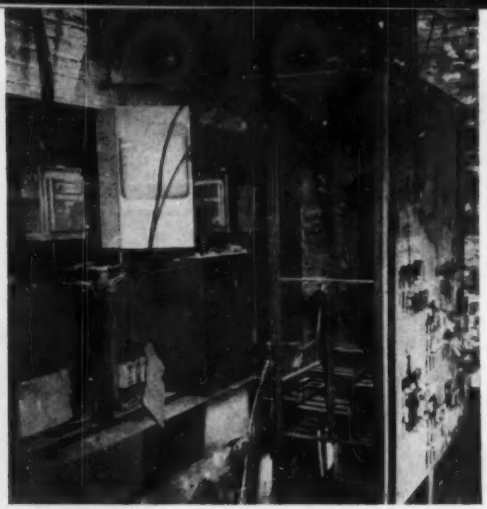
	Watts Per Sq. Foot								
	1	2	3	4	5	6	7	8	
Incandescent Types									
Commercial Indirect	4	8	12	16	20	24	28	32	Foot-candles based on average conditions
Commercial Diffuse	6	12	18	24	30	36	42	48	
Industrial Direct	8	16	24	32	40	48	56	64	
Fluorescent Types									
Commercial Indirect	7	14	21	28	35	42	49	56	
Commercial Diffuse	12	24	36	48	60	72	84	96	
Commercial Direct	15	30	45	60	75	90	105	120	
Industrial Direct	18	36	54	72	90	108	126	144	

be examined carefully in the early stages of design, to insure that adequate space has been provided for the wiring system and all component parts, such as transformers, main switchboard, feeder risers and horizontal runs, local panelboards, home runs, and branch circuits.

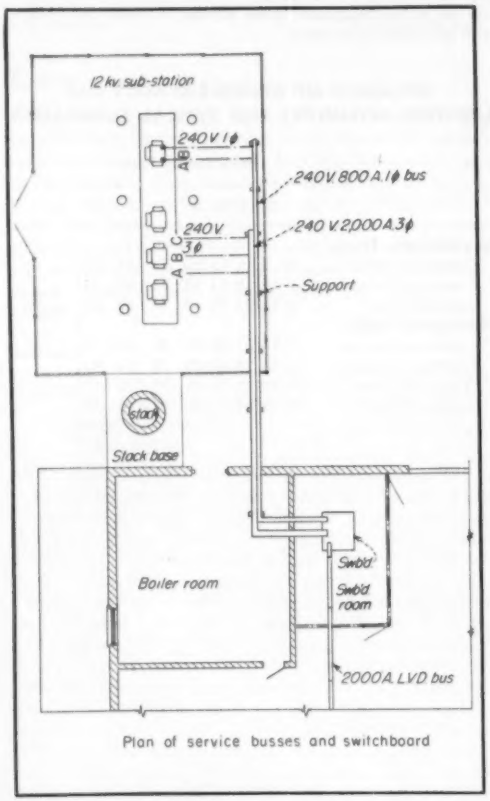
No general rule applies regarding location or space requirements for the electrical wiring system in any building. Both depend upon many factors, which must be considered in planning a modern wiring system. On remodelling jobs, location of service mains or power supply, and size and type of electrical load must be determined, and then all structural features of the building noted and studied carefully. Old wireway closets, elevator shafts, hollow walls, etc. should be spotted, and used for riser circuits. Space at columns within a room, or hollow sections in inner walls, and similar structural details, should be looked for and used wherever possible for branch circuits, switch legs, etc. Surface metal molding can usually be run behind beams on the ceiling, or down wood trim on columns, along the top of baseboards, over mouldings, and along other similar areas within a room.



SUBSTATION UNDER WATER TANK solves space problem on plant electrical modernization project. 300-kva. 3-phase unit at left transforms 13.2 kv. service to 120-208-volts for lighting; 750-kva. unit at right provides 480-volt, 3-phase power.



SERVICE CHANGEOVER is progressive in this hotel rewiring project. Last sections of old board at right. Submetering facilities at left. New panelboards are on opposite wall. Circuits are shifted after new equipment is in position.



Plan of service busses and switchboard

DUAL BUS DUCT SERVICE carries single-phase and three-phase 240-volt power from 12-kv. outdoor substation to switchboard adjacent to plant boiler room. Connections to transformer secondaries made through weather-proof service outlets on side of ducts. Parallel ducts are supported on angle-iron pedestals.

SERVICE

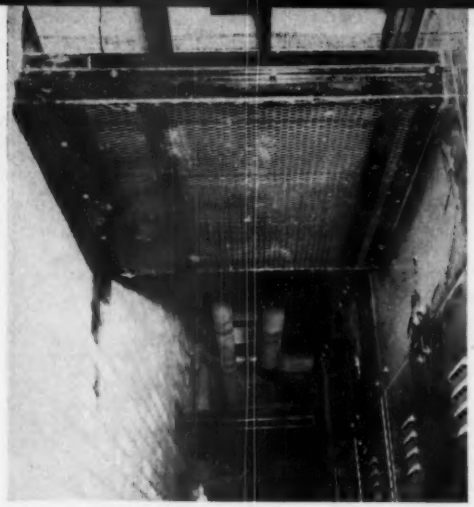
Service entrance installations normally include the conduit, conductors, poles, service entrance switch and equipment necessary to connect the building wiring to the power company distribution system. For the purposes of this discussion, the definition will be extended to include the main distribution cabinet in specific instances.

Electrically, the service may be of two distinct types: primary (above 600 volts); or utilization voltage (under 600 volts). Choice of service voltage is governed by local power company regulations and the engineering economics of the plant or building electrical distribution system.

Mechanically, services vary depending upon the entrance to the structure. Conduit and cable service drops on building exterior walls are standard practice when connecting to overhead transformer banks or overhead circuits supplying utilization voltage. Bus duct or enclosed bus systems are recommended for heavier services where multiple conduits and cables would be cumbersome and expensive. Low voltage underground services may consist of cables in conduits or ducts or approved cable for direct earth burial. Service raceways from underground vaults may be installed exposed or underground depending upon economic and customer considerations. For protection and safety, primary service conduits are installed underground in concrete envelopes or similar construction for exposed conditions.

Space Problem

Unlike new construction, electrical modernization work seldom offers clear sailing with respect to equipment location and space allocation. Service entrances must be carefully engineered to fit existing structural and space limitations. One method of solving the space problem is to install a multiple-switching or "hot sequence" service. This design eliminates the main disconnect switch or circuit breaker and carries the service bus direct to the distribution switches or breakers which are limited to six per service entrance. For systems requiring more than six feeders from a single service, the conventional main disconnect means must be installed ahead of the distribution panel.

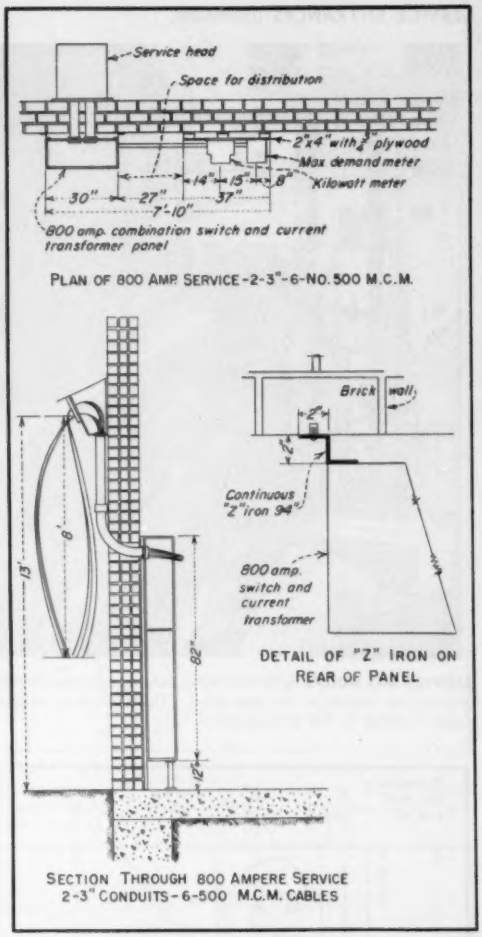


SHORT STUBS OF 4,000-ampere, 3-phase, 4-wire bus duct connect this commercial building switchboard with utility vault behind wall at left. One duct is for lighting load; other for power in the plant.

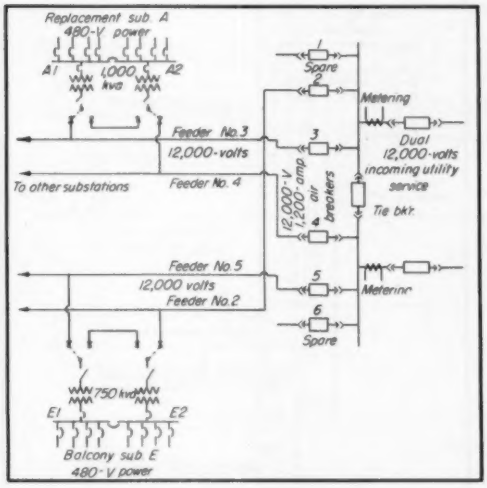
ENTRANCES

Since service modernization invariably means higher capacity, little, if any, existing equipment can be reused. To keep a plant operating during a changeover, the new service should be completely installed and circuit changeover made progressively. If the building can be shut down, the old service may be removed first and replaced by the new equipment.

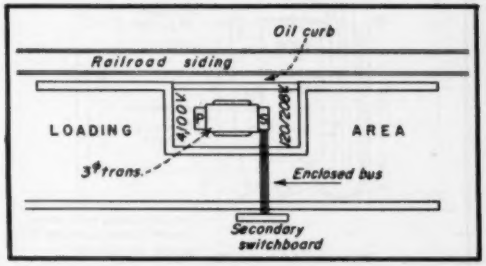
A sample cross-section of what some contractors have done to solve service problems is presented in the diagrams and photographs.



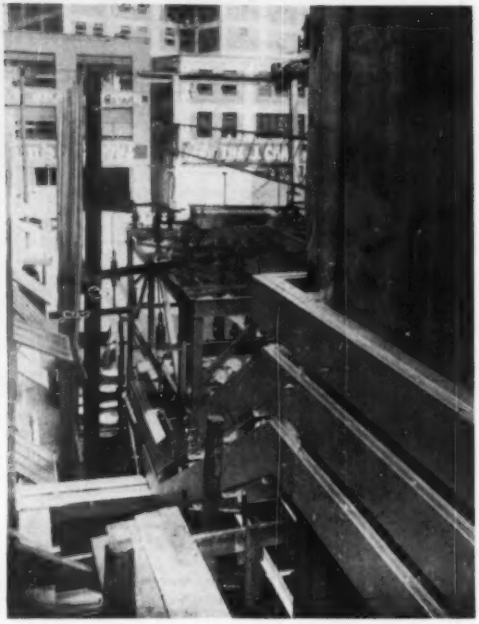
TYPICAL SECONDARY SERVICE of 800-ampere 3-phase capacity for industrial or commercial building served by overhead transformer bank. Dimensional data are minimum for layout that can be used either for new or modernization projects.



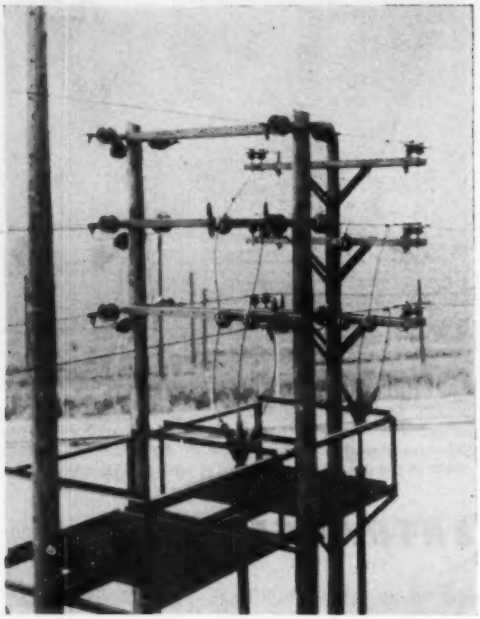
PRIMARY SERVICE to large industrial plant brings utility 12,000-volt power for distribution to unit substations throughout the plant. Transformation to utilization voltages occurs only at unit substations.



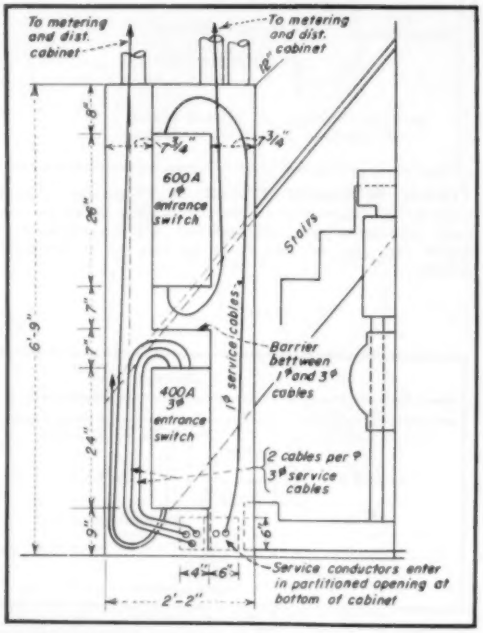
LOADING DOCK LOCATION of 600-kva., 3-phase transformer releases valuable plant manufacturing floor space. Switchboard hugs plant interior wall. Access to transformer is from rail siding.



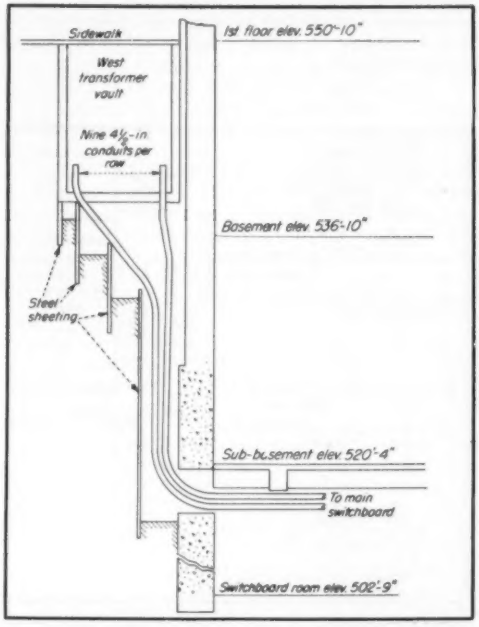
SERVICE BUS DUCTS from outdoor transformer substation feed distribution boards in this tool plant. Ducts are weatherproof type, installed in the vertical plane.



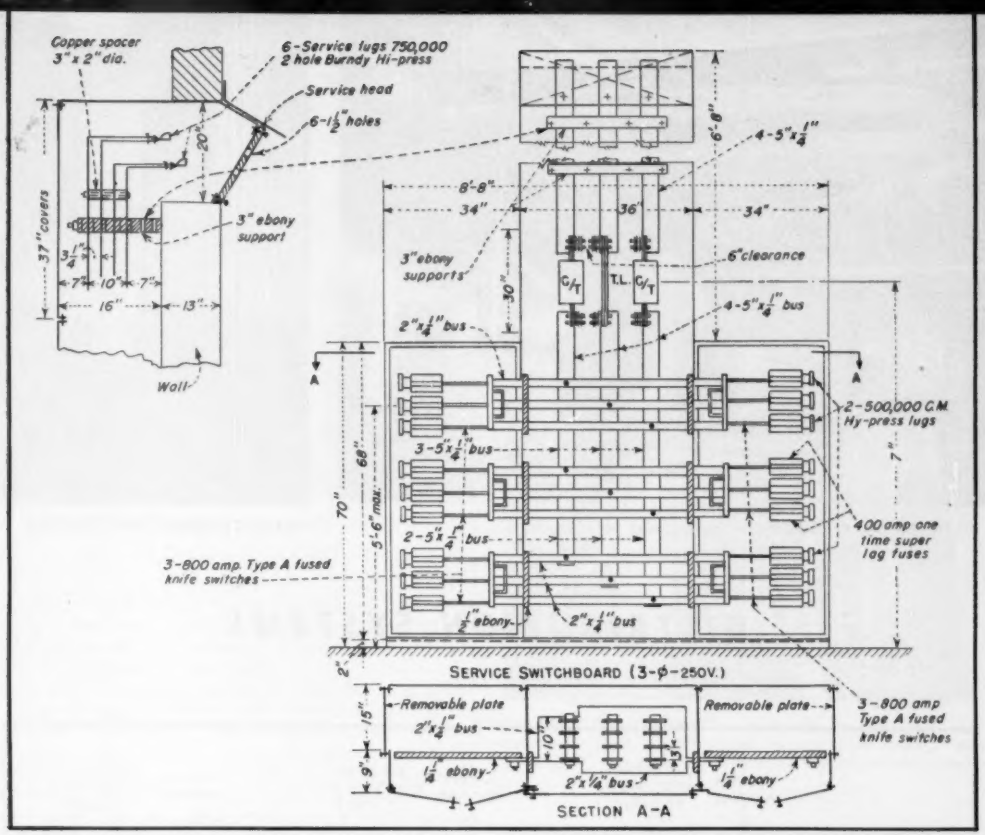
PRIMARY SERVICE TRANSFER platform. Dual 14.4-kv. overhead circuits go underground at this point to serve industrial plant load. Same voltage is distributed to unit substations.



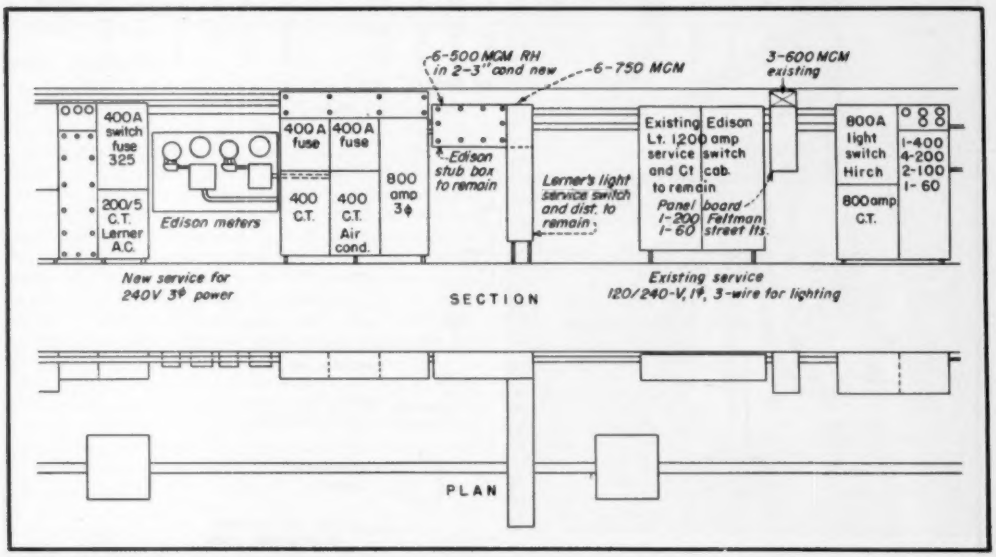
SPACE PROBLEM for dual service in stairwell is solved by single cabinet housing single-phase and three-phase entrance switches. Barrier in cabinet separates switches and cables.



UNDERGROUND SERVICE from utility sidewalk network vault to a hotel switchboard. Eighteen 4½-inch conduits drop from vault to switchboard room.

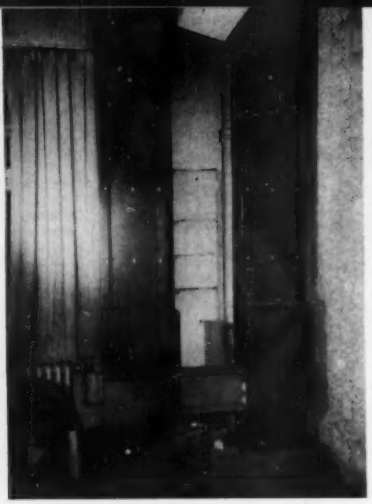


HOT SEQUENCE 250-VOLT, three-phase service of 1,200-ampere (800 amp. continuous load) capacity. Service bus terminates in service head 6' 8" above multiple-switch panel. Four parallel buses per phase are separated by 3-inch spacers to reduce heating and skin effect losses. Elimination of main service disconnect reduces cost and space requirements; also eliminates chance of complete plant shutdown due to main fuse failure.



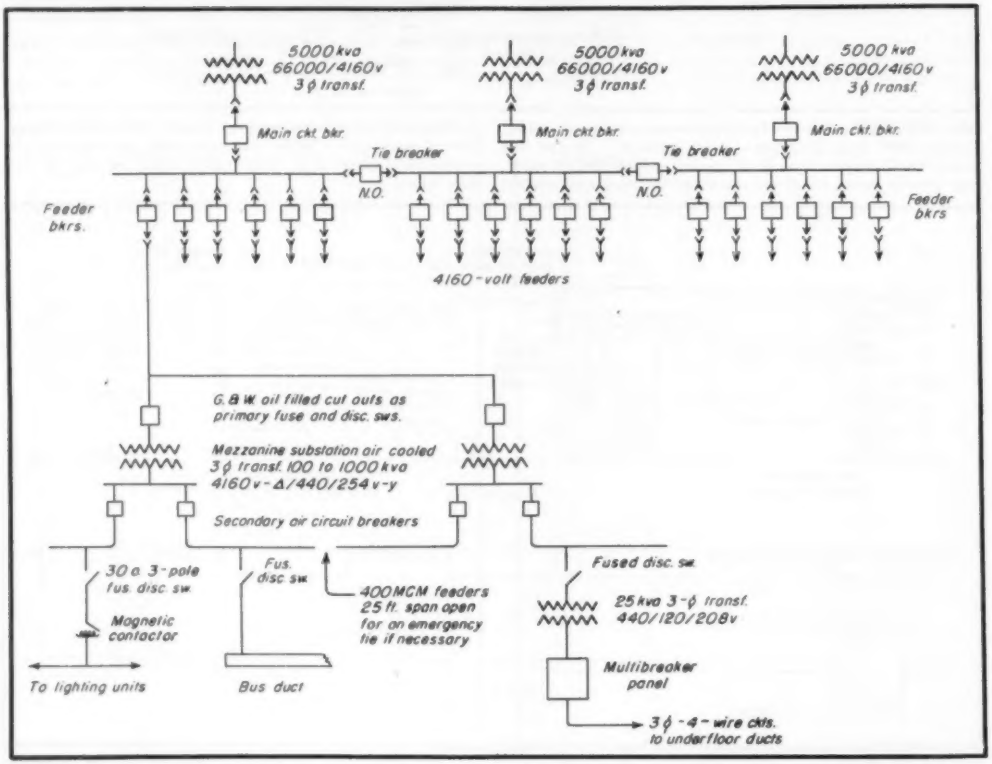
ADDING TO EXISTING service equipment is frequently feasible. Here additional facilities for air conditioning and power were added to existing service. Some lighting panels were also rearranged. Low ceiling conditions forced spreading panels along wall and termination of feeder conduits in face of cable pull boxes. Service is for a commercial building.

DISTRIBUTION CIRCUITS can be enclosed in conduits. . . .



BUS DUCT FEEDER risers as in store . . .

DISTRIBUTION SYSTEMS


5000 kva 66000/4160 v 3 ϕ transf.
5000 kva 66000/4160 v 3 ϕ transf.
5000 kva 66000/4160 v 3 ϕ transf.
Main ckt. bkr.
Main ckt. bkr.
Main ckt. bkr.
Tie breaker
N.O.
Tie breaker
N.O.
Feeder bkrs.
Feeder bkrs
4160-volt feeders
G. E. W. oil filled cut outs as primary fuse and disc. sws.
Mezzanine substation air cooled 3 ϕ transf. 100 to 1000 kva 4160 v-Δ/440/254 v-y
Secondary air circuit breakers
30 a. 3-pole fus. disc. sw.
Magnetic contactor
To lighting units
Fus. disc sw.
Bus duct
400 MCM feeders 25 ft. span open for an emergency tie if necessary
Fused disc. sw.
25 kva 3-ϕ transf. 440/120/208 v
Multibreaker panel
3 ϕ-4-wire ckts. to underfloor ducts

PRIMARY RADIAL distribution system installed in a large industrial plant. Tie breakers interconnect main primary buses in case a main transformer fails. 4,160-volt feeders serve individual substations throughout plant.

OR CABLE TROUGHS, depending upon space limitations.

UNUSED ELEVATOR SHAFTS are ideal for large groups of riser conduits. Shaft in this hotel modernization project was "floored-in" at various levels to house feeders and pull boxes.

Electrical distribution systems fall into two categories: primary distribution at more than 600 volts; secondary distribution at utilization voltages. Choice of voltage is a matter of engineering economics.

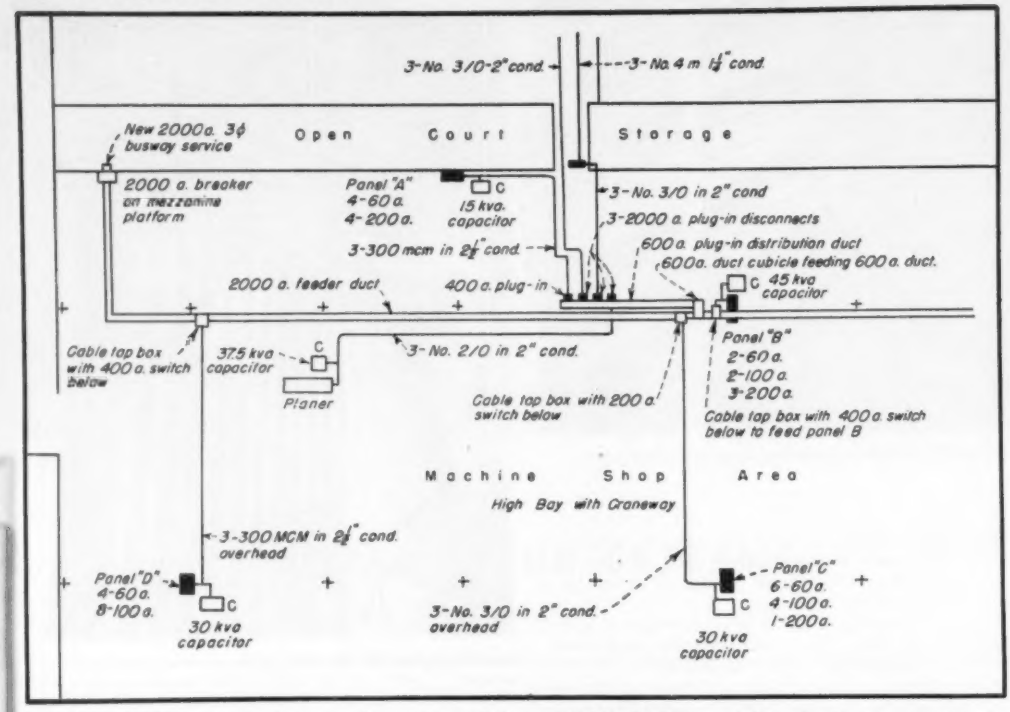
Choice of distribution circuit arrangement is a matter of engineering to fit specific plant or building requirements. Important considerations in this respect include: type of building; future changes in load requirements; load distribution (uniform or concentrated); possible changes in production setup; importance of service continuity; flexibility of distribution; voltage drop; size of feeder cables; and necessary interrupting capacities of switchgear. Each factor must be listed and balanced on the economic design sheet. It is not uncommon for engineers to make several different design layouts before finding the most economical and practical distribution system. All of these considerations apply to new as well as modernized electrical systems.

Space Limitation

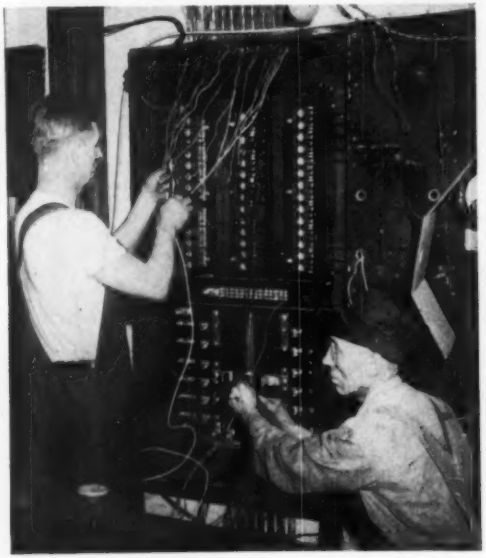
In modernization projects, the contractor faces other and more harassing problems. Once the system engineering is completed, he must install the equipment within the structural and space limitations imposed by the existing building. Unlike new work, he rarely has free access for feeder runs, switchboard locations, distribution cabinets and other items. He must, in effect, engineer the mechanics of the electrical installation. At the same time he must make provisions to keep the building operating while the modernization work progresses. All of this has a very important bearing on the labor cost for a modernization project. It is no secret that many successful contractors have won competitive modernization jobs by clever mechanical engineering of the electrical installation.

Available to the contractor are numerous types of raceways for distribution circuits; a variety of panel designs to fit specific structural conditions; power tools to speed the installation; cable insulations that permit increase in conductor capacity or installation in existing conduits. If there is nothing on the market to solve the problem, the contractor can—and frequently does—design an item and have it custom built. It is not unusual to use hollow and bar bus, bus duct, conduit, and cable troughs on a single modernization project. Each distribution method is chosen to fit specific structural limitations encountered. Some of

BUILDING STAIRWELLS can frequently be used for single or dual conduit risers. This feeder serves three floors of an office building.


3-No. 3/0-2" cond.
3-No. 4 m 1½" cond.
New 2000a. 3φ busway service
Open Court
Storage
2000 a. breaker on mezzanine platform
Panel "A" 4-60 a. 4-200 a.
C 15 kva. capacitor
3-No. 3/0 in 2" cond
3-2000 a. plug-in disconnects
3-300 mcm in 2½" cond.
600 a. plug-in distribution duct
600a. duct cubicle feeding 600 a. duct.
2000 a. feeder duct
400 a. plug-in
C 45 kva capacitor
Cable tap box with 400 a. switch below
37.5 kva capacitor
C
3-No. 2/0 in 2" cond.
Planer
Cable tap box with 200 a. switch below
Panel "B" 2-60 a. 2-100 a. 3-200 a.
Cable tap box with 400 a. switch below to feed panel B
Machine Shop Area
High Bay with Craneway
3-300 MCM in 2½" cond. overhead
Panel "D" 4-60 a. 8-100 a.
C 30 kva capacitor
3-No. 3/0 in 2" cond. overhead
Panel "C" 6-60 a. 4-100 a. 1-200 a.
C 30 kva capacitor

BUS DUCT FEEDER replaces old maze of secondary radial feeders in this machine tool plant. Main 2,000-ampere breaker on mezzanine platform releases valuable floor space formerly occupied by distribution switchboard. Conduit extensions from feeder pick up existing distribution panels. Capacitors are strategically located to maintain high power factor.



PANEL MODERNIZATION normally involves new interior assemblies. Frequently existing cabinet or "tub" can be retained and existing circuit conduits reused.

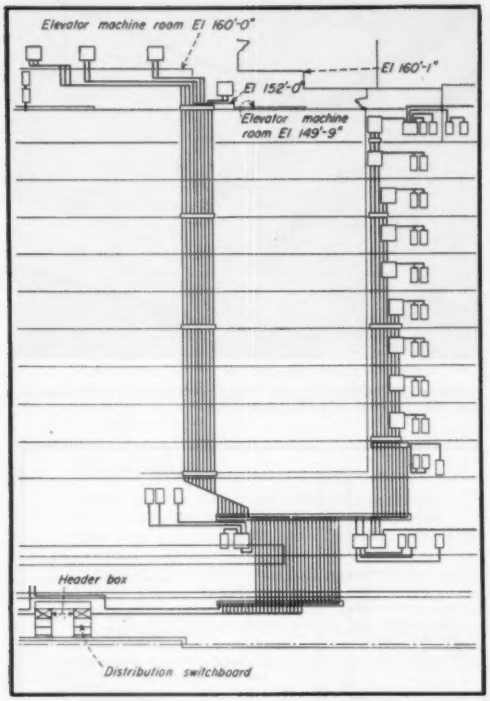
the things to look for in existing structures and some of the equipment available to meet various installation conditions are listed in tables on page 79.

Can existing electrical facilities be used in modernization work? This question has no definite "rule of thumb" answer. Much depends upon the characteristics of the specific job. The tendency to do this is more prevalent in commercial buildings where installation of new facilities might involve extensive cutting and patching. Frequently, existing panel enclosures or "tubs" can be used with new panel interiors—primarily because new panels are more compact than old ones of the same voltage ratings. The feasibility of rebuilding old panel interiors is questionable. The same is true of existing switchboard and distribution centers. A rebuilt unit is a patched-up job at best and the customer loses the benefits of advanced design and efficiency of new equipment. It is strictly a problem of engineering economics which the contractor and customer must resolve.

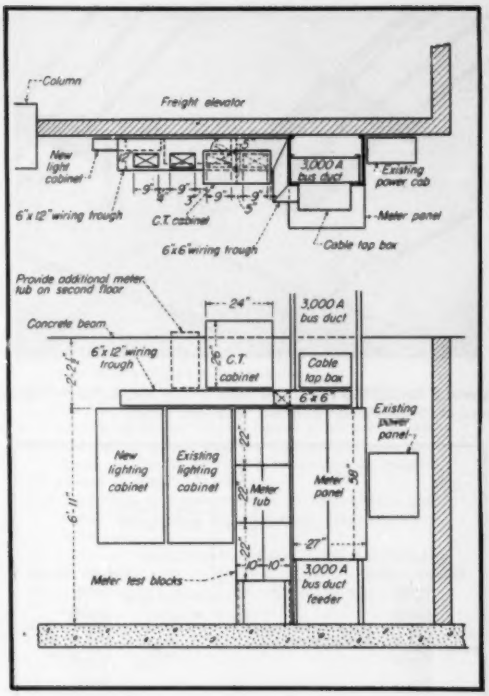
Existing Conduits

There are possibilities of using existing feeder conduits, if old cables can be easily removed, and if such feeders can conveniently be "killed" during the changeover.

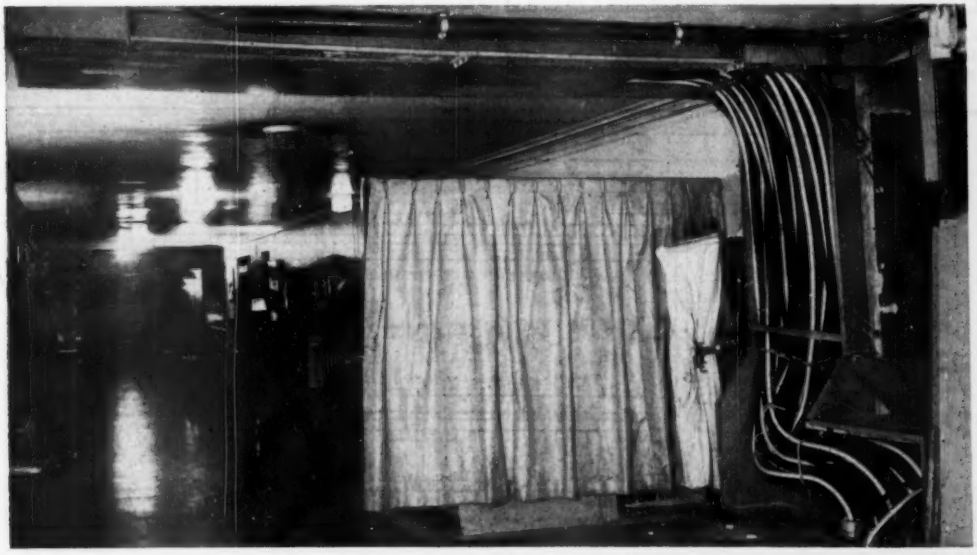
Rarely is a building unoccupied during an electrical modernization project. Hence, the problem of maintaining electrical service. There are two schools of thought on this subject. One is to install the new distribution system complete without touching existing facilities, then tie in present circuits. The other is to provide temporary wiring



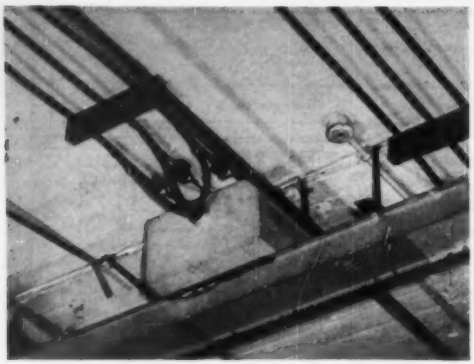
SECONDARY RADIAL distribution serving one-half of a large hotel. Risers shown replace old direct current system. Similar risers serve other half of building. Modernized system uses conduit, bus duct and cable troughs.

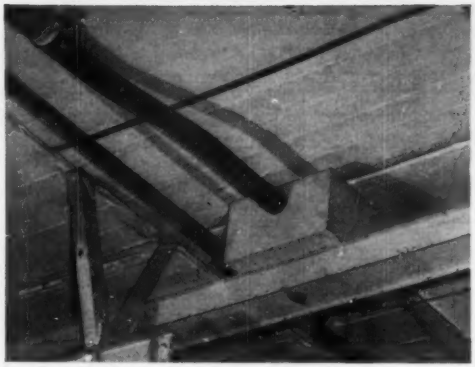


NEW AND EXISTING lighting panels in an office building are connected to new 3,000-ampere bus duct riser through special cable trough. Arrangement also provides for tenant sub-metering and necessary meter test blocks.

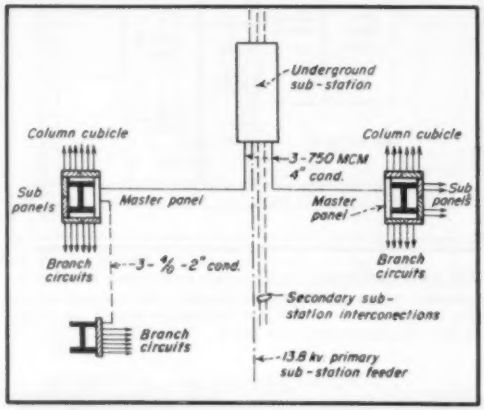


CABLE TROUGH carries new feeder conductors across hotel mezzanine corridor to riser location. Trough, pull box and panel at right will be enclosed in arch to be added later. Curtain was erected during period of modernization to block view from the hotel corridor and to permit the uninterrupted use of hotel facilities.

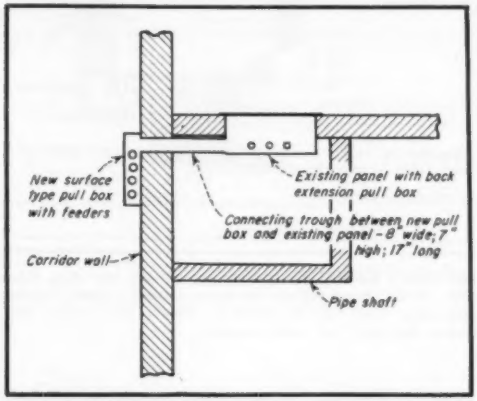




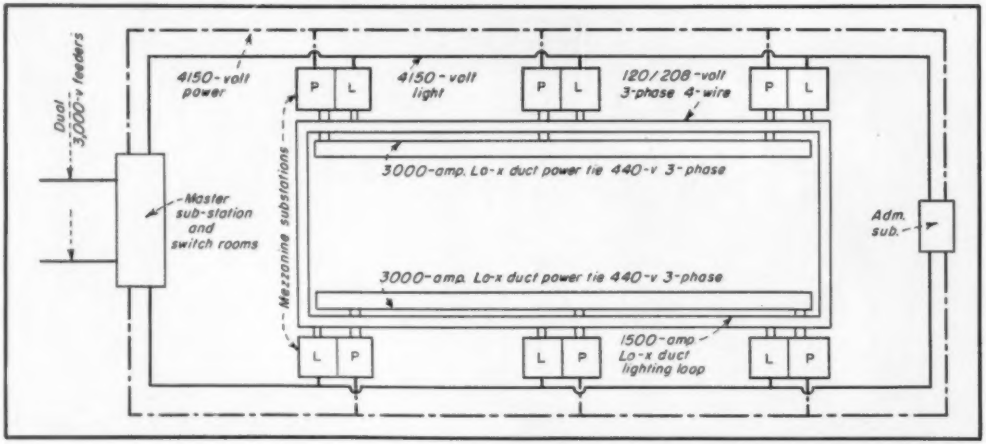
SIMPLE CHANGEOVER from open wiring feeders (left) involved addition of conduit raceway (right) in an auto plant rewiring project. Distribution bus duct remained intact.



COLUMN-MOUNTED distribution centers are fed by underground substations. Main primary and secondary feeders and interconnections are carried in concrete tunnel.


New surface type pull box with feeders
Existing panel with back extension pull box
Connecting trough between new pull box and existing panel - 8" wide; 7" high; 17" long
Corridor wall
Pipe shaft

CONNECTING TROUGH ties together surface type feeder pull box with existing flush type distribution panel; provides one solution to reaching existing cabinets in modernization work.



PRIMARY LOOP distribution in tractor plant. Dual feeders serve power and lighting sections of unit substations. Secondary bus duct loop (shaded) provides emergency tie on lighting system; 3,000-ampere bus duct sections serve as secondary tie on two groups of power substations. Bus duct distribution is used throughout the plant.

WHAT TO LOOK FOR IN EXISTING BUILDINGS

COMMERCIAL

Original electrical plans to determine existing feeder locations.
Structural plans to determine obstructions to new feeder locations and ability to carry weight of new feeder conduits.
Other piping and duct plans to avoid conflict in new feeder layout.
Unused elevator or dumbwaiter shafts as possible feeder locations.
Air shafts and stairwells as feeder location possibilities.
Underground tunnels and trenches.
Usable space for service and distribution equipment.
Access for connecting existing panels with new panels.
Possibility of reusing existing conduit raceways for new feeders.

INDUSTRIAL

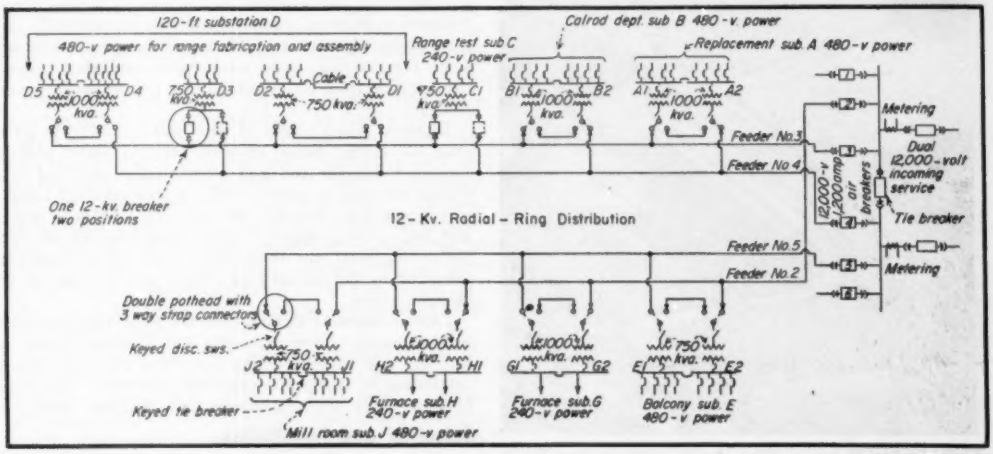
Usable space for service and distribution equipment.
Roof truss details for possible new feeder locations.
Other pipe and duct work to avoid conflict with feeder runs.
Feasibility of mezzanine locations for distribution equipment.
Possibility of using column-type distribution centers to get near load concentrations and yet save floor space.
Existing tunnels and trenches for possible feeder locations.
Mounting facilities for feeders and distribution equipment.

WHAT TO USE IN MODERNIZATION WORK

Conduit and cable where grouped feeders fan out to serve various distribution centers.
Aluminum conduit and aluminum cable where weight of feeders is a critical design factor (particularly in tall buildings).
Type RH insulated cable which provides about 19 percent more carrying capacity than conventional Type R of same conductor cross-section.
For rewiring existing raceways for increased load, where structural conditions preclude increase in raceway size, the Code permits 50 percent of conduit area to be occupied by conductors.
Cable troughs where structural conditions, pipe and duct installations obstruct clear path for grouped feeders.
Custom-built pull boxes and wiring troughs to circumvent structural or piping obstacles.
Multiple-switching or "hot sequence" service and distribution combination to save space in systems where distribution feeders can be limited to six per service.
Standard narrow column-type distribution panels to save space, or custom-built distribution centers around column locations.
Unit substations to transform power at concentrated load centers and reduce to a minimum long secondary feeder runs.
Air cooled or non-inflammable liquid filled transformers to eliminate vault construction.
The variety of cables and ducts for underground distribution.
Any of the standard items of distribution equipment and accessories that can be engineered into the specific project at hand.

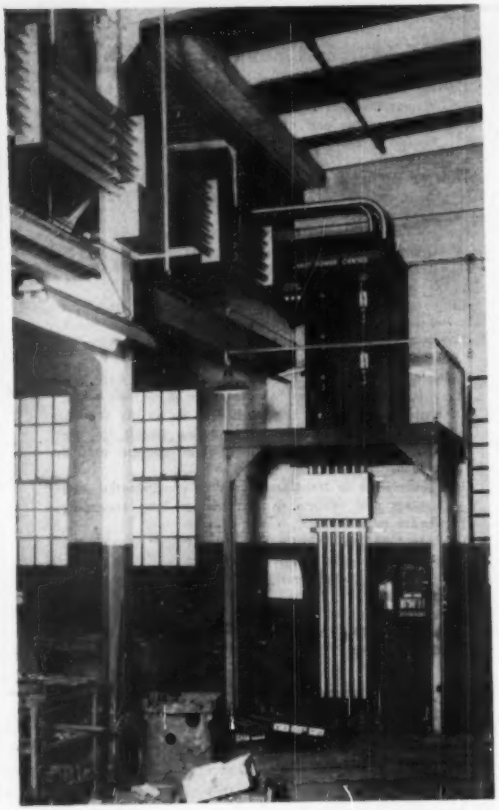
and incorporate usable portions of existing facilities in the new distribution system. The former is generally used in commercial buildings where temporary wiring and interruption might be objectionable and present a psychological hazard. The latter is more often used in industrial plants where temporary facilities can be installed in roof trusses. Again there is no definite rule that can be formulated. It is a matter of cost and preference to be decided between owner and contractor on each project.

What can be done with old distribution panels that have been replaced in the modernized system? Removing them presents a major problem in commercial buildings where facilities are concealed and flush-mounted. Best solution is to utilize these panels as pull or splice cabinets and carry their branch circuits back to the newly installed panel. Branch circuit conduits need not be disturbed. In industrial plants with exposed circuits, old panels can be removed and branch circuit conduits extended to new distribution panel.

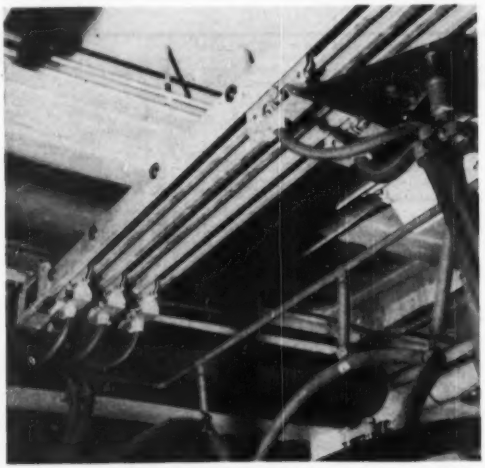


RADIAL-RING PRIMARY distribution combines a modified radial and modified selective primary system to assure service continuity. Prudent use of secondary tie-breakers, keyed primary switches, primary tie-feeders and spare main feeder capacity provides unusual and economical operating flexibility and dependability.

POWER CIRCUITS



LOAD CENTERS, large or small, serve the triple purpose of permitting currents to be carried at higher voltages closer to points of utilization, controlling the flow of current, and protecting circuits and equipment from abnormal conditions.



TROLLEY DUCTS can be obtained with capacities from 50- to 600-amps., with straight or curved sections ranging from 1- to 10-feet in length, and with terminal and receptacle-type trolleys having twistout provisions.

Circuit Protection

Modernization demands that circuit protection be carefully analyzed so as to quickly disconnect electrical equipment in the event of excessive overloading, faulty operation, low voltage or low current. In power circuits 600 volts or below, protective equipment consists of fuses, circuit breakers, thermal and magnetic devices.

With low-melting-point zinc alloy links having one or more reduced sections near the center, fuses (by NBFU specification) carry 110 percent of rated current indefinitely but blow in varying lengths of time when currents rise to 150 percent of rated fuse capacities.

Time-lag fuses prevent blowing under momentary overloads, opening instantly under short-circuit conditions but designed to safely carry large motor-starting surges of currents for brief intervals.

Circuit breakers often serve a dual function; acting as switches as well as overcurrent devices. They differ from fuses in that they have two mechanisms; one to detect excessive currents, the other to open the circuit. They operate either on the thermal principle, magnetic principle, or a combination of the two. Design offers time-lag provisions to maintain current through starting-surge intervals.

While small breakers normally have a simple break arrangement to interrupt the circuit, the life of breaker contacts is increased materially through the utilization of arc quenching and magnetic blowouts.

Low-current breakers are still largely controlled manually, although breakers with higher ratings are often closed by solenoids or motors and opened by trip coils.

Thermal relays consist essentially of three parts; a heat-producing means, a heat-responsive device, and a contact mechanism. In general, they are of two types: bi-metallic (with metals of different coefficients of expansion bonded together so that, when heat is applied and the strips expand at different rates, a bending action of the element will take place), and solder pool (with rachets under spring tension held from moving except when heat melts a solder bath surrounding the rachet). Thermal relays, designed to be reset either manually or automatically, are most commonly used to protect motors against overload, since they require little maintenance and they prevent the machine from being willfully or unintentionally overloaded.

Magnetic relays consist of wire coils connected in series with the circuit being protected, with a metal plunger located within the coil and mechanically connected to a circuit-interrupting switch. When a predetermined amount of current flows through the coil, the plunger is raised and the switch is opened. To give time-delay, an oil dashpot arrangement can be included, with the time interval governed by the viscosity of the oil and the size of the dashpot orifice.

Thermo-magnetic devices combine these two principles, with magnetic action protecting the connected motor on starting, and thermal action protecting the unit against continuous or frequently-recurrent overloads. This combination gives accurate inverse-time overload protection.

Selection and Installation

Before modernizing existing power-circuit layouts, it is well to decide whether the rearrangement or replacement of equipment would be advantageous, whether feeders

should be enlarged, whether the scrapping of old methods and materials for new ones would be justified, whether safety would be enhanced. Reduction of voltage drop is another factor to be considered, for efficient operation of equipment depends upon the delivery of current having adequate voltage. Secondary runs of great length should be avoided and conductors should be liberally sized.

Because of ease of assembly and installation, flexibility and salvability, *plug-in busways* are finding increasing applications in power circuit modernization. For best layouts, however, the designer should (1) use only standard fittings, (2) select current ratings for maximum practical loadings, (3) favor parallel runs of low capacity to a single heavy-duty installation, (4) taper the busses as loads are reduced along the runs, and (5) correct low power factor by the judicial installation of capacitors.

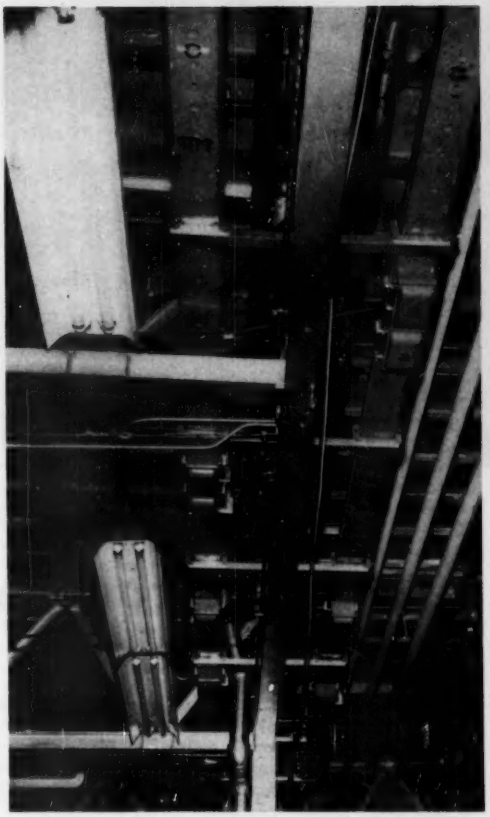
Midget Busduct

Although plug-in busways formerly came only in 10-foot sections and were rated for 600-, 400- and 250-amps., the new *midget* plug-in lines now include a 50-amp duct with both 5- and 10-foot sections. Due to its compactness, it can be fastened by straps to the wall, ceiling or along the back or under a machine bench, or supporting hangers from the ceiling or roof for a group of small drill presses or punch presses requiring connections for a ½ to 3-hp. motor at 240 volts or less, ac or dc. Plug-in outlets are spaced every 20-inches along the midget bus, the duct measures 2- by 3-inches OD, and enclosed copper bus bars measure ¼ by ½-inch. Plug-in devices, fitted with standard 30-amp. fuse connections, are provided with spring prongs to catch and lock on the inside of the duct for support and dependable ground connection.

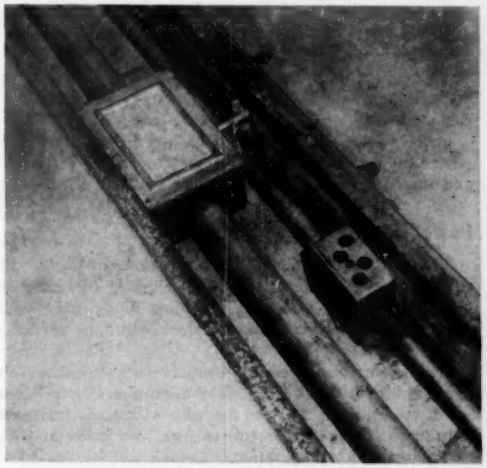
Trolley busways are also increasing in popularity, with sections measuring less than 1- by 2-inches in cross-section, coming in sections from 1- to 10-feet in length, and rated for 50-amps., 250-volts. Trolleys for many applications are available; terminal and receptacle types with or without twistout provisions. Sections are quickly assembled with couplings, and trolley runs can be fed either from the ends or at any convenient intermediate point. With curved as well as straight sections available, trolley-duct is particularly applicable for light-weight monorail and crane installations, and accessories make it possible to mount the sections to walls, ceiling, structural members such as I-beams, or from messenger cables strung between roof trusses.

Where floors can be channeled or are being resurfaced, power distribution can be facilitated by floor trenches or *underfloor raceways*, providing flexible floor outlet systems while maintaining unobstructed overhead clearances. To anticipate further expansion, it is usually necessary to install more wiring space than is absolutely essential, but mechanical protection is excellent and the appearance of the area is free and clean. Underfloor raceways can be installed as single, double or triple compartments, all three having standard junction boxes. In this way, power circuits can be segregated from telephone and signal systems in separate channels.

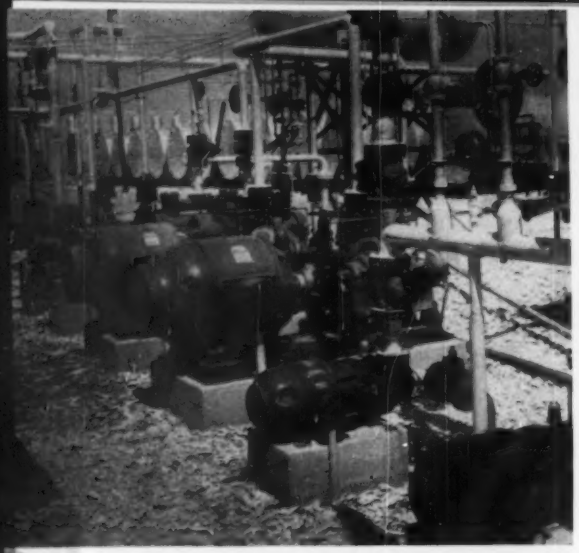
A variation of underfloor raceways consists of adjustable floor boxes set flush with the floor surface and connected by a buried rigid conduit or EMT network. Boxes are waterproofed by integral gaskets, their roomy interiors provide ample space for working with circuit connections, a zinc coating protects them against destructive elements and adjustment screws make it possible to quickly raise, lower and level the boxes.



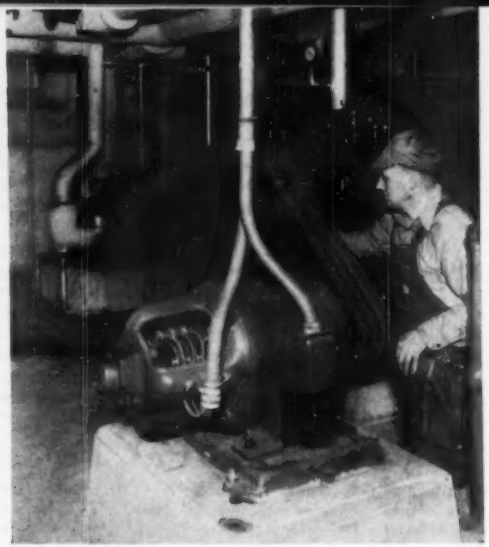
DISTRIBUTION of power through plug-in busways establishes convenient outlets for branch circuits. Flexible and easily assembled, sections and standard accessories can be quickly shifted should power requirements warrant.



FLOOR TRENCHES, underfloor raceways and systems combining adjustable floor boxes with conduit or EMT networks distribute power to local areas in an easily-accessible, protected and neat manner.



EXPLOSION PROOF induction motors are used for locations such as exist at this southern oil refinery. Motor selection depends upon power supply, end use and surrounding conditions.



SLIP RING MOTOR with V-belt drive is selected for operation of such equipment as this triplex piston pump installed in a mid-western government building.

MOTORS and CONTROLS

Selection & Application

Motor modernization is a three-step procedure. First, all possible uses for motorized operation should be investigated. Second, motors, either new or on-hand, should be selected for the specific operations in mind. And third, motor application and installation should be in conformity with manufacturers' recommendations.

Possible uses for motorized operation are limitless. Constantly-increasing opportunities exist in the industrial, commercial and residential fields for improving efficiency, economy, comfort, convenience or safety through planned motorization. Power—either rotational or converted to other forms of motion—is being advantageously applied for such diverse operations as lifting, turning, boring, blowing, pumping, compressing, drilling, threading, agitating and mixing. And only by using power in its many forms can modernization be completely attained.

Correct selection of motors involves factors relating to power supply, the nature of the operation to be performed, and surrounding conditions.

Power Supply

Voltage, phase characteristics, current frequency and type of power should be carefully checked for, although standardization is becoming more and more nation-wide, scattered areas still operate under conditions distinctly local in character.

It is almost redundant to mention that nameplate voltage and circuit voltage should be approximately the same, yet it is surprising to note the wide variations frequently existing. Within 10 percent, voltages can differ and still permit satisfactory operation.

Phase is another point to be checked, for although 3-phase supply is normal and desirable, 2-phase power still exists in certain areas and only single-phase is offered in most rural and residential districts.

Since 2-winding, multispeed motors are difficult to wind for 2-phase power, transformation to permit the use of 3-phase motors is recommended. And, where a change of direction of rotation of the driven machine would cause serious results, the power supply should be checked to determine the possibility of phase reversal and phase-failure relays should be considered.

Frequency is predominantly 60-cycle throughout America. Yet 50-, 40- and 25-cycle current is provided in local areas, and higher frequencies can be provided for special high-speed applications.

Another power supply consideration is economic, for energy charges, power-factor clauses and demand charges may affect the choice of motors and controls. Some utility rates adjust charges in accordance with plant power factor; others include bonuses for power factors above 90 percent, and penalties where pf is below 75 or 80 percent. Where power factors can be improved by installing synchronous motors or capacitors, the possibilities should be explored.

Voltage regulation has a two-way effect; first, on the motors and controls and second, on the supply system. For example, a motor might lack sufficient starting or running torque under low-voltage conditions. And, conversely, high starting currents may cause dips in circuit voltage, affecting fuses or opening breakers.

If continuity of power is essential, automatic transfers to shift the loads to other power sources, or standby equipment may be required. Sustained low voltage may demand higher-torque motors. And time-delay undervoltage protection may be required where dips in voltage result from intermittent switching.

Operation Factors

The *mechanical arrangement* of the machine being driven by the motor usually determines whether a vertical or horizontal motor should be installed. For example: Grease-lubricated motors are satisfactory for either mounting

MOTOR SELECTION CHART

SINGLE PHASE

Fractional hp. general purpose, split-phase open motors
Use for constant-speed moderate-torque applications where high starting torque is unnecessary. Oil burners, office appliances, small machine tools are typical applications.

Fractional hp. general purpose, open, capacitor motors
For constant-speed applications where relatively high starting torque is required or where minimum noise is essential, such as for commercial refrigeration units, air conditioning equipment and fans.

Shaded-pole motors for small devices and appliances
Small, constant-speed units for operating small fans, instruments, motion-picture projectors and small devices not requiring a high starting torque.

Universal varying-speed series motors
Small, compact, high-speed motors for operating paint sprayers, sirens and similar applications where duty is intermittent, where load is fairly constant and where constant speed is not essential.

Totally enclosed motors
Use where magnetic or abrasive dusts, extreme moisture, severe fumes or chemical conditions exist.

Vertical motors
Use on water-pump assemblies and similar applications.

POLYPHASE

Fractional hp. general purpose, open motors
Use for all constant-speed steady-running jobs, where ordinary surrounding conditions exist. With high starting torques, these motors are recommended for hard-to-start applications. They have smooth acceleration and high maximum load-carrying capacities for emergencies.

Fractional hp. industrial and machine-tool totally-enclosed motors
Built specifically for machine tool and industrial applications where frequent start-stop service, plugging duty and metal-dust applications are present.

Splashproof motors
Use in wet, splashing locations, where hosing-down or outdoor rainstorms strike the enclosure.

Totally enclosed motors
Standard construction is suitable for dust, fume and moisture locations that are not explosive. Special construction should be specified in explosive atmospheres such as grain elevators or mills.

Vertical, shielded and general-purpose motors
Made for turbine and jet pumps, centrifuges, irrigation projects, agitators and machine tools where protection against dripping water or falling objects is required.

Wound-rotor collector-ring motors
Use on jobs where adjustable speed is needed but where slight speed changes under fluctuating load is permissible. Also good for low starting current and smooth acceleration.

Synchronous general-purpose motors
Use where good power factor is desired, where maximum efficiencies are desired for continuous loads of 75-hp. or larger, where exact speeds are necessary, and where low speeds are wanted.

DIRECT CURRENT

Fractional hp. general purpose, constant-speed, open motors
Use where fine speed adjustment warrants the use of d-c motors plus a-c-d-c conversion equipment, or where the supply is d-c and constant-speed applications exist.

Adjustable-speed motors
Use for applications where it is desirable to obtain a large variety of accurately controlled speeds over speed ranges of more than 3:1.

Crane and hoist motors
Designed for heavy-duty work where frequent start-stop operation is present.

GEAR MOTORS

General-purpose motors
Designed for applications where load is fairly constant and must be driven at low speeds.

GENERAL

Self-starting synchronous induction motors
Recommended for electric instruments, regulating devices, remote-control apparatus and other applications where long life power source at constant speed is needed.

position, while oil-ring-lubricated sleeve-bearing motors will run dry if tilted or inverted. Operation of motors in positions for which they were not designed will also change the thrust characteristics, and end shields should be rearranged to give designed protection.

Methods of connection, such as direct, belt, chain or gear, are also factors to be considered. Where required machine speed and available motor speed are the same, direct connection should be considered, and built-in construction (with shaft and bearings common to both motor and machine) investigated for possible effect on maintenance, power factor, space, efficiency and cost of the assembly.

Another factor is that of *space limitations*, affecting decisions on built-in construction, the use of a gear-motor, forced ventilation with an external blower, or the use of a smaller frame with a Class B insulation to permit higher operating temperatures.

Speeds, the necessity for synchronous operation with other machines, the possibility of reverse operation, and required horsepower are additional determining points related to operation. So, also, are starting and acceleration torques, the inertia of rotating parts of the driven machine, the exerted axial thrust on the bearings, and required rate of deceleration.

Frequency of starting will affect the motor and control by increasing their heating, particularly when accelerating times are lengthened by high load torques.

Finally, magnetic controllers for the remote operation of machines, and automatic controls for governing the machines through changes in pressures or temperatures should be considered.

Surrounding Factors

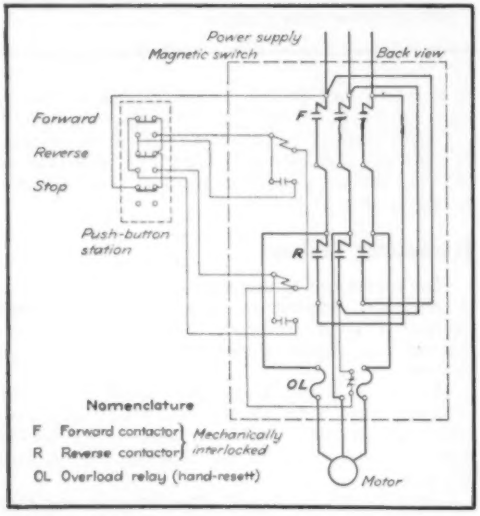
Since normal ambient temperature is assumed to be below 40 degrees C, temperatures above this limit may dictate changes in motor insulation, and temperatures below freezing may require a substitution of a light-weight lubricant.

Altitude is another surrounding factor, for electric machinery runs hotter in rare atmospheres and, above 3300 feet elevation, machinery temperatures increase approximately 1 percent for each additional 330 feet above sea level.

Corrosive, explosive or dusty atmospheres likewise affect motor selection, since they dictate special insulations, special enclosures and special ventilation arrangements. And, similarly, motors to be installed outdoors usually necessitate total enclosure against rain or snow, changes of lubricants in conformity with the seasonal temperature

COMBINATION MAGNETIC SWITCHES such as these G. E. units controlling 7½-hp. spray-pump motors are easily installed, have protective provisions and permit remote operation from accessible location.

METAL-ENCLOSED CONTROLLER with high interrupting capacity and current-limiting power fuses is inspected to check condition of contact tip of heavy-duty oil-immersed contactor.



WIRING DIAGRAM or correction print accompanies control apparatus for guidance in installation. This diagram of a typical a-c reversing magnetic switch, pushbutton station and motor indicates temperature overload relay and 3-pole contactors.

changes, and weather-resisting finishes and paints.

The possibility of splashing or submersion deserves attention. For motors operating under water for long periods will require special enclosures with counter air pressures inside the housing to prevent the entrance of water, occasional flooding will require enclosed non-ventilated equipment with stuffing boxes, and occasional hosing-down operations recommend splashproof motors.

Still another factor to be considered is the sound level created by the motor. Installations in public buildings, hospitals, residences and the like may require special sound-absorbing mounting facilities, sound-proof motor rooms or flexible connections.

To insure that power connections are approved, mounting dimensions and types of control in order, fire and accident precautions provided and construction in accordance with governing codes, standards and ordinances, reference should be made to NEMA and AIEE standards, National Electrical Code, state and city laws.

Selection

Regardless of the thought behind the selection of a distribution system and the application of the correct motor for specific operations, overall plant efficiency rests heavily on the proper selection of motor controls. For many applications, *magnetic controls* are essential, and they are to be preferred in the majority of cases. However, when *manual* controls are correctly installed, adequately serviced and

intelligently operated, they have many uses and, within their capabilities, will render satisfactory service.

For example; manual controls should definitely be considered where motors are started and stopped infrequently, such as those driving constantly-running ventilating equipment or line shafts. Also, when it is possible to mount the control convenient to the operator, manual operation is feasible. Since manual controls are generally less expensive than magnetic devices, they warrant consideration whenever conditions dictate.

As *frequency of starting* and stopping increases, however, the maintenance and renewal of worn parts increases more rapidly for manual controls than for magnetic devices and, when starts and stops occur every 8 or 10 minutes, magnetic controls have positive economic advantages.

Size of motor also governs control selection, for manual control of large motors may be relatively difficult to operate and, if the duty cycle occurs frequently, manual operation will result in rapid operator fatigue.

Space conservation frequently determines the selection of a controller site removed from the motor it controls. In such a case, a magnetic control panel at the remote point and a small pushbutton station at the machine for the operator is suggested. Since only small control wires need be run between pushbutton stations and the controller, added operating convenience can be obtained by installing a number of pushbutton stations for the same motor, or control type limit switches can be substituted for the pushbuttons.

Where a series of operations must be *synchronized*, such as for a multi-motored conveyor line, interlocked magnetic controls are a *must* if material piling-up is to be avoided. With interlocked magnetic controls, the last motor in the line would be started first, then the next to the last motor, and so on back to the first motor. The stopping procedure would be reversed, with the first motor stopped first and the last motor in line stopped last.

In selecting controls, thought should be directed to *undervoltage release* and *undervoltage protection*. Both have their applications. With undervoltage *release*, a motor is de-energized during a power outage but it will restart when power returns to the circuit. This is desirable for ventilation fans and water pumps where automatic restarting is essential without attention from an operator. With undervoltage *protection*, the motor is disconnected when power failures occur but it will not restart without the attention of an operator. This type of device is essential where the simultaneous restarting of all motors in a plant would result in a circuit-straining overload, or where the unexpected restarting of a motor-driven lathe, saw or drill would constitute a hazard.

While manual controls are generally less expensive in initial cost, the conveniences of magnetic devices make them preferable for industrial and commercial applications.

FUNCTIONS OF CONTROLS

1. **Limit current to the motor during the acceleration period**
2. **Limit starting torque, proportional to the current multiplied by the field strength**
3. **Change the rotational direction of a motor**
4. **Limit the load, through the incorporation of overload relays**
5. **Disconnect the motor in the event of voltage failure**
6. **Govern rotating speed through armature control, changing the field strength or changing the supply voltage**
7. **Start and stop the motor at the travel limits of the load or at fixed points in the operational cycle**
8. **Stop the motor by either dynamic or friction braking, and**
9. **Protect the operator against shock, burns or mechanical injury.**

Installation

Location of controls is governed by regulations (NBFU, State and City), safety provisions, operation convenience and space available. For manual controls, location should be near the operator and machine and, if magnetic controls include hand-reset overload relays, the hand-reset button should be conveniently mounted.

However, magnetic controls can be mounted remotely in out-of-the-way places such as at ceiling levels or on upper walls, keeping working areas free. Of course, with this arrangement, the pilot-circuit device or pushbutton must be located within easy reach of the operator. Remote installations are not subject to damage by passing industrial trucks or moving equipment, but sufficient accessibility should be provided for maintenance inspections, and sufficient space must be available to permit doors to be swung open and to permit the safe movement of the maintenance man. Location is also governed by feeders.

Drafts and vibration are other conditions affecting the operation of controls. For open-type panels with thermal overloads, if subjected to drafts from fans or opening outside doors, will not operate in accordance with design. And excessive vibration may likewise be a potential source of faulty operation. To guard against these factors, controls should be enclosed, mountings should be firm, free circulation (not drafts) should be facilitated by the installation of enclosure louvers, and the ambient temperature should be as nearly as possible like that of the motor controlled.

Excess heat, like excessive coolness caused by sudden drafts, will affect the operation of temperature overload relays so controllers should not be located adjacent to steam pipes. And, unless enclosed with special housings, controllers should be removed from splashing acids, alkalis, oil, water and similar liquids.

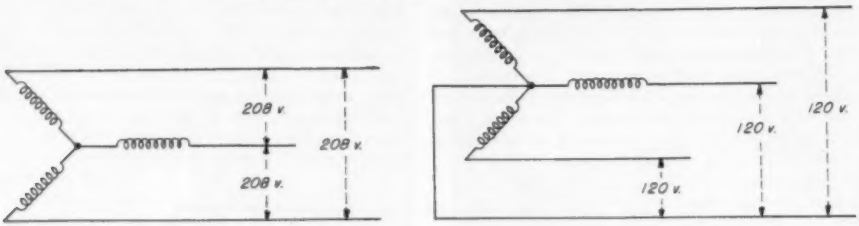
Special enclosures are also available for protecting controls and controllers from corrosive fumes, hazardous gasses and moisture, but it is frequently more economical to install controllers in a separate room where the damaging or hazardous conditions are absent. In such instances, the cost of extra conduit and wire is frequently less than the investment for protective equipment.

Functions

It is theoretically possible to incorporate in a motor, devices to prevent the motor from being injured, and to prevent injury to the driven machine under all conditions. However, this would greatly increase the cost of the motor and decrease its general efficiency. Therefore, controllers are designed to supply these missing functions, (see box) and the motor and controller should be thought of as a single operating team.

For 3/40-watt Lamp Fluorescent Luminaire . . .

. . . What Branch Circuit Voltage is Most Desirable? . . .



. . . THIS?

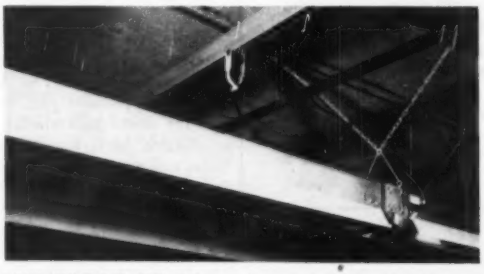
. . . or THIS? . . .

OPERATION OF 3/40-WATT LUMINAIRE WITH 3-LAMP BALLAST

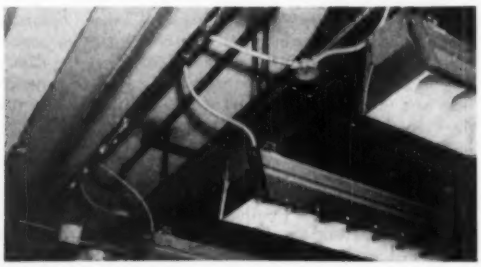
Circuit Voltage	Watts Loss	Line Current (amps)	No. Lamps
110–125	23	1.30	3
199–216	16	.70	3
220–250	20	.60	3

OPERATION OF 3/40-WATT LUMINAIRE WITH ONE 2-LAMP AND ONE SINGLE-LAMP BALLAST

Circuit Voltage	Watts Loss	Line Current (amps)	No. Lamps
110–125	15.5	.85	2
	9.5	.50	1
Total	25.0	1.35	3
199–216	11.5	.50	2
	8.5	.29	1
Total	20.0	.79	3
220–240	12.5	.43	2
	9.5	.26	1
Total	22.0	.69	3



LOW CURRENT BUS (50 amp.) is used as branch circuit to feed individual lighting strips with plug-in connection.



BRANCH CIRCUITS in flexible cable are fed through conduit to service individual troffer units.

METAL HOUSING for recessed lighting troffers serves as wireway when units are installed in continuous rows.

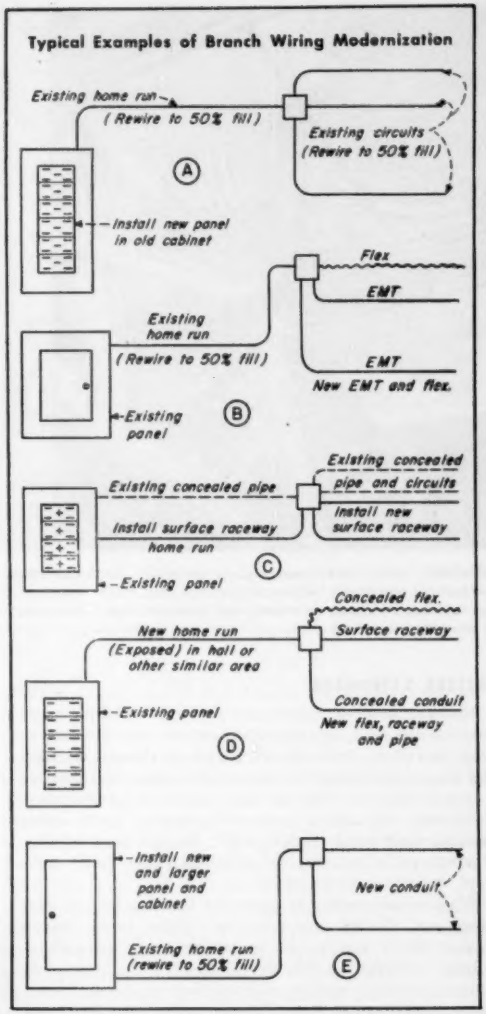
CIRCUIT WIRING

Trends toward standardization have greatly simplified such problems as the selection of branch circuits and related wiring materials and installation methods. In an electrical modernization program, however, there is some opportunity for analysis of branch circuit details and requirements, and for adoption of unusual or special engineering design, installation methods and construction techniques which can be shown to have economic merit.

Modernization of a branch circuit wiring system entails the layout or routing of circuits, making effective use of existing conduits or other raceways, including surface extensions and special raceways, and the selection and installation of adequate and flexible switching and control. Many of the requirements for a branch circuit wiring system are fixed, either by the lighting, appliance, or special loads to be served, or by the primary characteristics of the energy supply. In such cases the design engineer must of necessity work within these limitations.

All practical rules used for circuit layouts on new work should be followed in the design and layout of branch circuits for jobs of modernization, insofar as this is possible and practical. Loads should be calculated based on type of occupancy, on unit loads for appliances and lighting, on demand factors, permissible voltage drops, and on possible load increases in the future. This will not always be economically sound practice, as in many cases it would mean discarding all old branch wiring equipment and installing new equipment with larger panels, conduit and conductors, and at a high unit cost due to handicaps faced in making the installation. Good practice often becomes a compromise between installation of what is desired and of what is required, and of sacrificing some desirable features for the sake of economy.

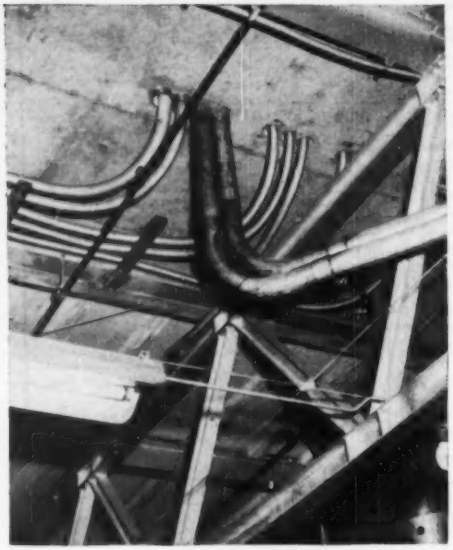
Old circuits should be checked, and reused wherever practical. If new circuits are to be run, use of present conduit or raceways should be made, if possible. This can often be done by pulling in small diameter wires up to permissible percentage fill, to provide added capacity using the old installation.



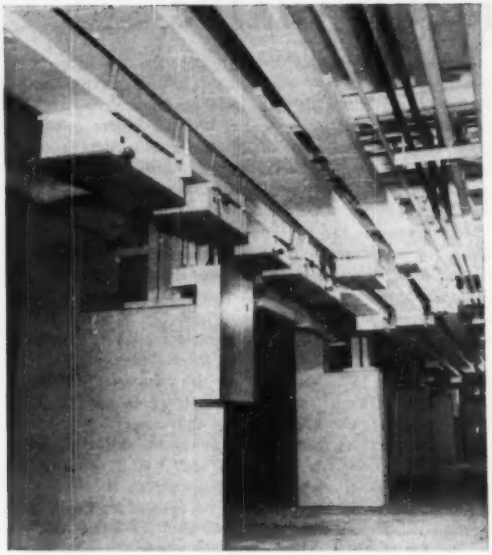
PERMISSIBLE CROSS-SECTIONAL AREAS OF CONDUCTORS

(In Percent Area of Conduit or Tubing)

	Number of Conductors				
	1	2	3	4	Over 5
Conductors (not lead covered)	53	31	43	40	40
Lead covered conductors	55	30	40	38	35
For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions	60	40	50	50	50



CONDUIT, rigid and metal, gives excellent electrical and mechanical protection to branch circuit wiring. Thin-wall tubing, although lacking in mechanical strength, has many uses in protected locations.



PLUG-IN BUSWAYS permits branch locations to be established close to utilization points. Switches, ground indicators, capacitor plugs and other plug-in accessories provide wide variety of services.

Surface Extensions

Modernization of branch circuits involves three problems: installing a complete new system in a building or area, extending the scope of a system already installed, and revamping obsolete or inadequate circuit arrangement.

One method by which all three problems can be solved is through the use of *surface extensions.* Such wiring includes rigid metal conduit, EMT, flexible metal conduit, armored cable, non-metallic sheathed cable, metal raceways, busways and wireways.

Rigid metal conduit is permitted in all types of occupancy and all locations. Also, in addition to its surface applications, it can be run in hollow spaces of walls or ceilings, embedded in masonry or concrete fill, covered by plaster or run in shaftways. Providing maximum protection for conductors, it can be used under all atmospheric conditions, provides a dependable grounding system and permits the replacement of conductors that become overloaded or damaged. With a variety of surface finishes for corrosion resistance, with a wide assortment of fittings and with many hand and power-operated tools available for threading, bending, cutting and tightening, the design and installation of a rigid metal conduit system can be accomplished with maximum precision and safety.

Electrical metallic thin-wall tubing weighs about a third as much and also gives complete mechanical protection to conductors carried.

Flexible conduit has the added advantage of flexibility and can be readily fished in otherwise inaccessible areas. It is also easily adapted to following architectural forms and can usually be concealed behind trims.

Armored cable is installed in the same way as flexible metal conduit. One limitation is that armored cable is not a raceway and conductors cannot be removed. Another limitation is that circuits are relegated to 600 volts or less. However, with a wide range of wire sizes, number of conductors, type of insulation and obtainable with either solid or stranded conductors, armored cable has many applications for connecting lighting units, machine tools, small motors, switches and controls.

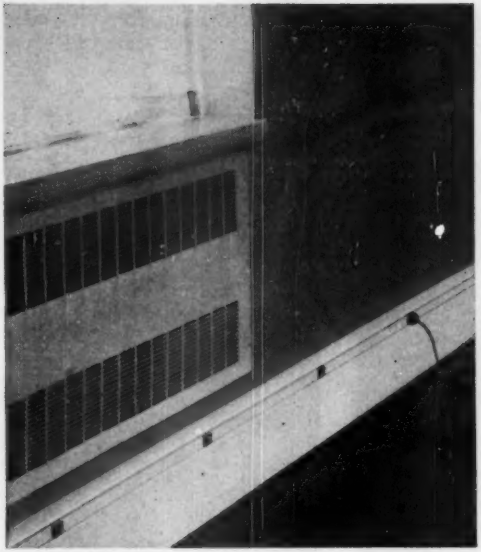
Open wiring on insulators provides flexibility and accessibility on industrial feeders. Heat is rapidly dissipated due to the surrounding air, and greater current-carrying capacities are possible for this reason. However, caution must be exercised in the selection of open wiring locations, for mechanical protection is at a minimum.

Special Raceways

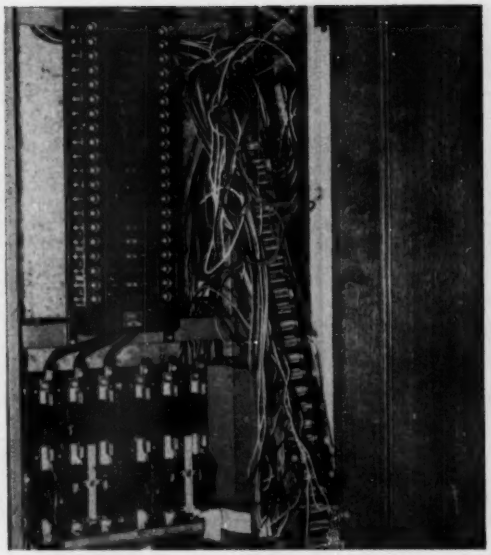
Surface metal raceways provide the means for carrying exposed wiring in a neat, accessible, safe and sturdy manner. Raceway can be fitted closely to harmonize with architectural trim. With covers and channel separated, the system can be installed prior to the laying-in of wires; conductors can be readily removed or replaced as local requirements dictate, and a complete assortment of fittings and accessories provide flexibility, attractiveness and convenience.

As previously mentioned, secondary *busways*—plug-in and trolley—when properly selected and installed carry current to utilization points with minimum voltage drop and provide readily accessible outlets and means of connecting electrical equipment to distribution systems.

Having standard ratings of 250-, 400- and 600-amps., *plug-in busways* permit the establishment of convenient connections at any desired point. Final connections to equipment are shortened while flexibility and safety are obtained through the inclusion of plug-in switches, ground indicators, capacitor plugs, circuit breakers and static voltage protectors. With bare conductors supported within the metal enclosures, both circuit and personnel are protected and, with a wide selection of elbows, cross-overs, tees, plugs, expansion joints, flange connections and tap



SURFACE METAL RACEWAYS are easily installed, safe, sturdy and neat in appearance. Covers are readily removable, permitting the changing or addition of wiring as requirements shift or increase.



PANELBOARDS are usually designed with double row of switches and fuses although narrow single-row panels are available for H-column mounting. Switches control circuits and provide protection during re-fusing and maintenance.

boxes, it is possible to design systems for most structural conditions.

Movable receptacles and outlets are possible through the use of *trolley* busways, thus providing users of power tools and other electrical equipment, with greater freedom of movements. With contacts between the protected busbars and the movable trolleys provided through brushes or roller contacts, connections slide freely along the extent of a production line or other working area. Trolleys also are useful for lighting installations, permitting individual fixtures to be shifted or respaced as lighting requirements are altered.

In the sense that they consist of prefabricated metallic troughs supported at regular intervals, *wireways* are similar to busways. However, loose insulated conductors replace busbars within the enclosures. For exposed work in dry locations not subject to mechanical abuse or corrosive fumes, wireways are excellent, although they are not recommended for hazardous locations, hoistways or rooms housing storage batteries.

Switching and Control

Branch circuit panelboards, used to control and protect small-capacity circuits (50 amps. or less with voltages below 300), can consist of a single panel or a group of panel units designed for assembly in the form of a single panel. Including busses, with or without either switches or automatic overcurrent protective devices branch circuit panelboards control light, heat and power circuits of relatively small individual and aggregate capacities. Modern design places these panels in cabinets or cutout boxes, accessible only from the front and installed on or in walls, columns or partitions.

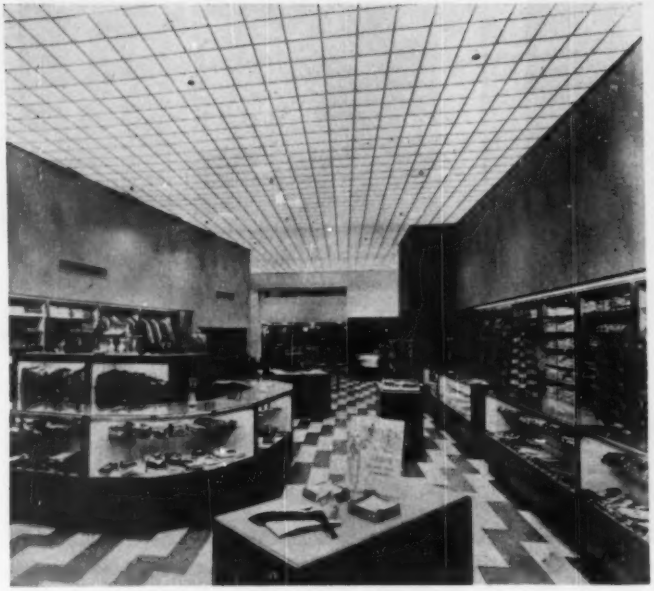
Modernization in panelboard design offers opportunities to fit more circuits into existing cabinets. Both fuse and circuit breaker types are available in compact design.

While branch-circuit panelboards are usually designed with a double row of fuses, circuit breakers or switches, panels may be obtained for industrial applications having a single row, permitting the installation of the board within the limits of standard H columns. Such panels usually have their junction boxes either at the ceiling level or at the top of the column, with feeder and branch neutrals terminated at this point. Branch circuit conductors can be carried from this junction box to the column-mounted panel either through a large conduit or wireway.

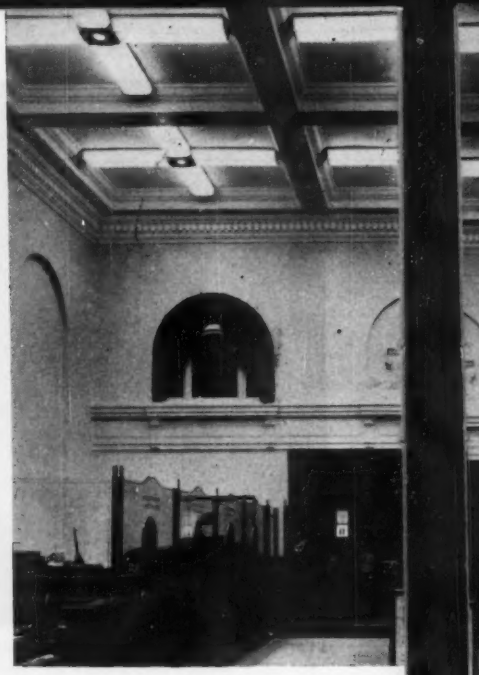
Use of existing cabinets in commercial modernization is often practical. However, when service must be maintained during wiring modernization, it is often preferable to leave existing panels undisturbed until all new wiring is completed. New panels are installed near or adjacent to the existing cabinet. When new feeders are installed, the existing panel can then be removed and existing circuits (if any) transferred to the new panel.

Both electrical and physical factors should be considered in locating the panelboards; keeping them away from dampness or corrosive fumes, placing them conveniently for maintenance without obstructing manufacturing processes, keeping them as close as possible to load centers so that branch circuits will be shortened, and balancing the loading of circuits between phases of a polyphase system or the sides of a 3-wire system.

In any modernization program, attention should be given to minimizing manual effort in controlling electrical equipment connected to branch circuits. This suggests motor activation (valves, brakes and rheostats), magnetic operation (contactors, relays and solenoids), thermal units (thermostats), static accessories (capacitors, rectifiers and resistors), mechanical switches (limit, float, pressure or speed-sensitive) and remote-control pushbuttons and controllers.



NEW LIGHTING SYSTEM in this apparel shop lights show windows, floor and wall cases, and general sales area. Intensities range from 120 footcandles general lighting to 215 footcandles in show windows. Large cell wood louvers in ceiling conceal 40-watt fluorescent strips and R-40 reflector spots.



CUSTOM DESIGN LUMINAIRES using standard lighting units were installed in large ceiling coffers formed by deep beams in this bank. Replacing old orna-

SPARKLE AND GLITTER in this remodelled jewelry store is created by incandescent units recessed in suspended ceiling. Fluorescent lamps in reverse coves, floor, and wall cases, provide general lighting and create a cheerful decorative effect.

LIGHTING

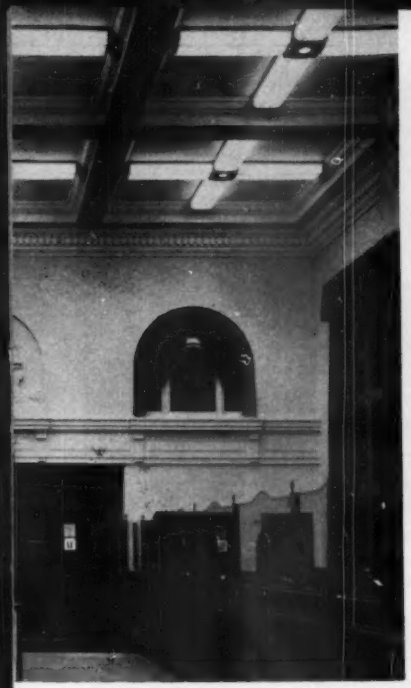
Lighting modernization, or relighting, accounts for a high percentage of the number of electrical modernization jobs done each year. Combined with its counterpart, rewiring for lighting, it represents one of the biggest markets dollar-wise in the entire electrical construction industry.

The size of any lighting modernization job is not fixed. It can be big or small. In fact, its size is determined only by the customer, who is to pay for it, and the sales ability of the salesman or sales engineer who designs and sells it. However, sales ability is not measured in terms of high pressure selling, in the case of relighting, but in terms of benefits—increased production, increased sales, increased seeability, decreased spoilage of products, decreased eye strain and headaches, better employee moral, etc.—benefits which the salesman can properly appraise for the customer based on the facts surrounding each relighting project.

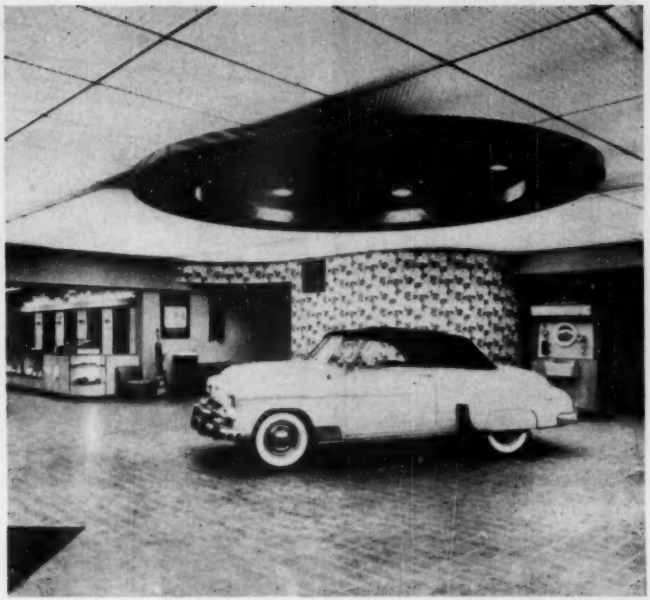
Problems Encountered

Every relighting job presents its own peculiar problems. Some of these are major, and require careful investigation and analysis, but on the average these problems are minor.

Inadequate wiring and the problem of increasing the wiring capacity to meet the demands of a new modern lighting system, are the most common problems encountered in relighting. These problems are treated in detail elsewhere in this feature, under "Distribution Systems" and "Branch Circuit Wiring". They include insufficient



mental units suspended from beams, the new lighting system accents the ceiling height. Lighting intensity was increased from five to 60 footcandles average.



LOUVERALL LIGHTING with plastic louvers provides ideal diffuse illumination for display of automobiles in this relighted Rochester, N. Y. salesroom. General illumination is 60 footcandles. Incandescent 200 watt downlights installed in circular element add sparkle to bright finished metal parts of autos.

MODERNIZATION

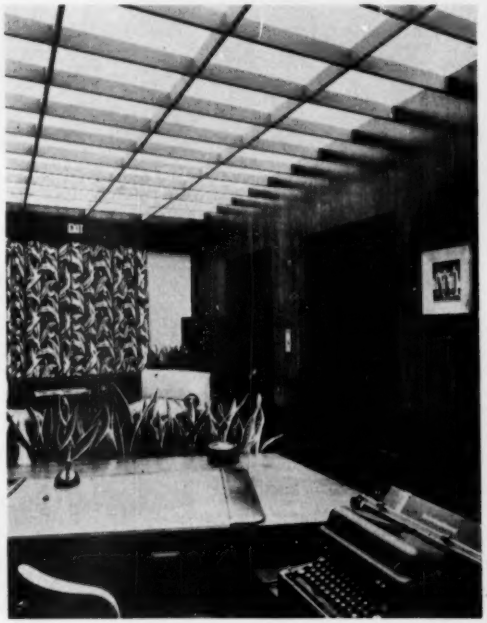
capacity (number and size of conductors), limited conduit size, limited size of lighting panels, remote location of old outlets from point of use required by the new lighting system, and other similar problems.

Structural obstructions, and mechanical services equipment often present a problem for locating lighting equipment where desired, or called for from a design standpoint. Beams of steel or concrete, solid walls of various building materials, air conditioning ducts, heating pipes, water pipes, and similar obstructions present problems on most relighting jobs. These and other similar problems must be considered before a new lighting system is selected, and later in fitting the new layout to the old facilities.

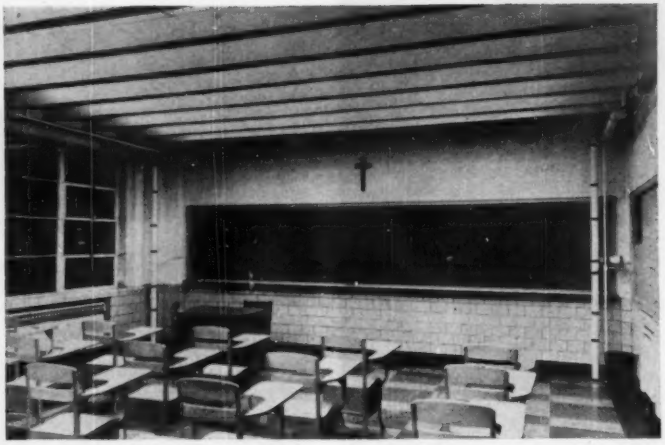
System Selection

The end use application of a lighting system is one of the major governing factors in its selection. The type of visual tasks is another which predetermines the lighting result, or lighting effect. The first step in selecting a lighting system is therefore the determination of the end use application and seeing tasks which will obtain, and of the lighting result or lighting effect which is wanted.

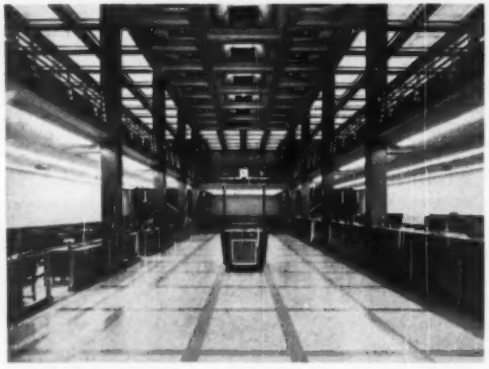
Lighting equipments and components fall naturally into broad classifications of lighting systems. These systems are known as louverall or luminous ceiling, troffer, continuous row surface or suspended, individual unit, recessed incandescent, etc., lighting systems. Each system is also classified according to light distribution, such as direct,



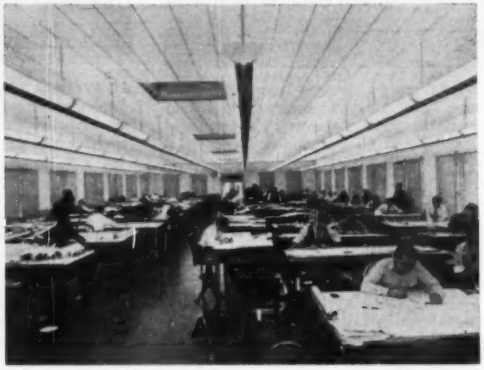
LUMINOUS CEILING in this reception room is formed with plastic sheets supported on wood louvers. Fluorescent lamps installed three feet above the plastic sheets light the panels evenly and provide 50 footcandles below.



STRUCTURAL ELEMENTS forming natural coffers are utilized in this high school classroom to shield the lighting equipment and to obtain a low brightness ceiling at normal viewing angles. A single-lamp fluorescent strip light, concealed with flat diffusing panels, is installed continuous in each coffer. Intensity is 70 footcandles average.

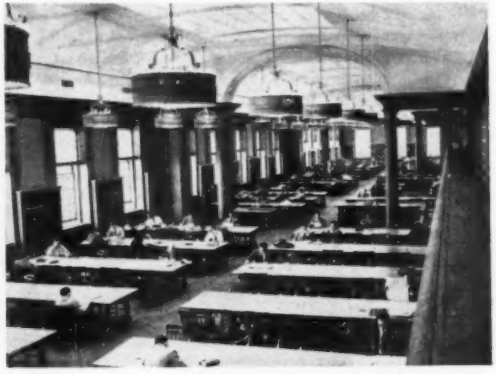


INTEGRATION of lighting equipment and architecture provides unusual decorative treatment and good lighting. Continuous troffers light first floor work areas, coffers light balcony.



EYE COMFORT LIGHTING with continuous row luminous indirect fluorescent units provides 98 footcandles average in this relighted drafting room. Light diffusion eliminates shadows.

RELIGHTING in this erecting shop involved a 218 kw. lighting load, and consisted of 52—3000 watt Type A-H9 units and 52-1000 watt incandescent lamps in concentrating high bay reflectors. Horizontal illumination is 20 footcandles average.



ARCHITECTURAL FEATURES were utilized in relighting this library. Cold cathode tubing lights coves. Three-lamp troffers are installed over louvers in skylight area, and old suspended luminaires were modified to use a 750-watt bowl-silvered lamp.

CONCEALED LIGHTING UNITS provide soft quality direct and indirect lighting in this church, highlighting the main and side altars. Nave is lighted by high bay reflectors recessed in ceiling domes, and by R-40 lamps concealed in coves and at top of pilasters. Altars are highlighted with R-40 lamps concealed behind pilasters.

semi-direct, general diffuse, semi-indirect and indirect. Each system can be still further classified according to type of light source, such as fluorescent, incandescent, mercury vapor, or a combination of these sources.

In lighting modernization the above factors must be considered the same as on new construction. In addition, the method of installing must be analyzed to see that equipment can be recessed, or that new wiring for additional capacity can be installed, and that there will be no conflict between structural elements or mechanical equipment and the proposed new lighting equipment.

Equipment Selection

Lighting system selection to considerable extent determines the lighting equipment selection. For example, if a continuous row recessed troffer lighting system is called for, the equipment choice narrows down to the limited number of troffer unit designs available from a small number of lighting equipment manufacturers. Factors entering into the selection of the equipment then include low cost, quality material of heavy gauge for reflectors and housings, high grade components such as ballasts, starter switches and lampholders, ease of installation and maintenance features, and efficient light output with adequate shielding.

Use of Architectural Features

A current trend in lighting design is the integration of the lighting system with architectural elements and decorative features. This integration is practical on lighting modernization jobs just the same as on new construction work. Fortunately for the lighting designer, most old structures have high ceilings and new structures are using much lower ceilings. Thus, it is feasible to modernize the lighting in an old building by installing a luminous or louver ceiling at ten or eleven feet from the floor and still have space available over the luminous ceiling to install reflectors and light strips at correct spacings and mounting heights, and to conceal necessary wiring extensions. Or, a new acoustical ceiling can be suspended in the area and recessed lighting equipment can be installed in the ceiling.

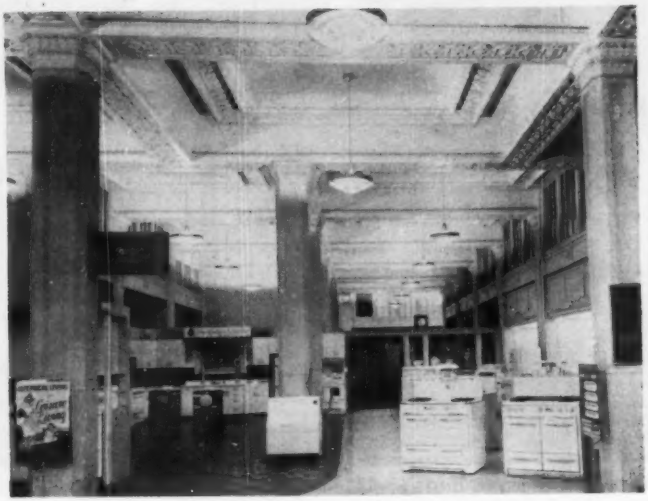
CONTINUOUS ROW fluorescent units provide general lighting in this food market. Recessed spots and downlights provide accent lighting for special displays.

CONTINUOUS ROW closed end industrial reflectors of the two 85-watt T-17 lamp type, installed on ten-foot centers, 17 feet from floor replaced incandescent units and gave a new intensity of 60 footcandles in this machine shop.

LIGHTING MODERNIZATION (continued)

LIGHT FOR SELLING was easily achieved in this Home Appliances Salesroom, without rewiring, by replacing old 1300 watt ornamental multi-lamp luminaires with efficient 1500 watt semi-silvered bowl single lamp luminaires. Intensity was increased from ten to 34 footcandles. Incandescent units were selected because of their low first cost.

BEFORE



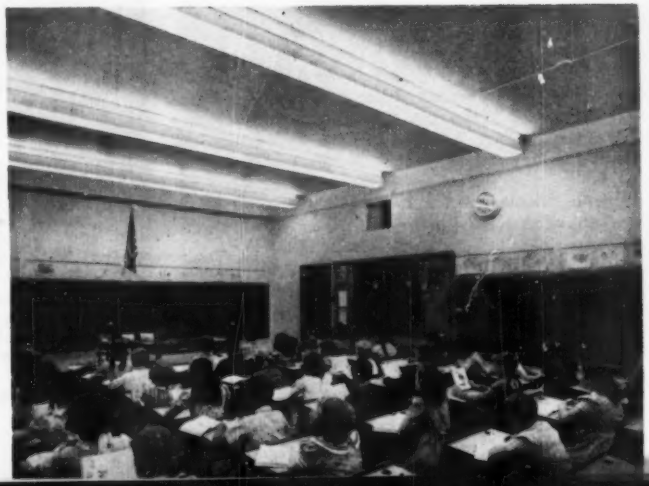
AFTER

NEW CLASSROOM with facilities for 25 students was provided in this New Jersey school by modernizing a basement storage room. Old windows were widened, and new walls, ceiling and floor were installed. Continuous row louvered luminaires, installed on eight foot centers, produce 50 footcandles of comfortable lighting maintained average.

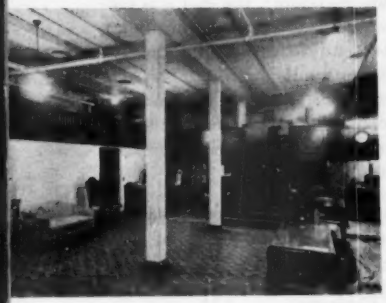
BEFORE

AFTER

RELIGHTING of this classroom provided 50 footcandles average intensity. Old system of four 100-watt enclosing glass globes produced less than two footcandles average. New lighting layout is based on four rows of two-lamp surface type troffers, eight feet apart, with rows running normal to students' line of vision to attain greatest shielding.



NEW LOUVERALL LIGHTING system and clever use of venetian blinds to conceal an open balcony transposes an unattractive fur store interior into an ideal setting for sale of high class merchandise. Louverall ceiling conceals exposed beam, pipes and metal ceiling. Intensity of 75 footcandles results from use of 200 ma., 4500-degree slimline lamps.



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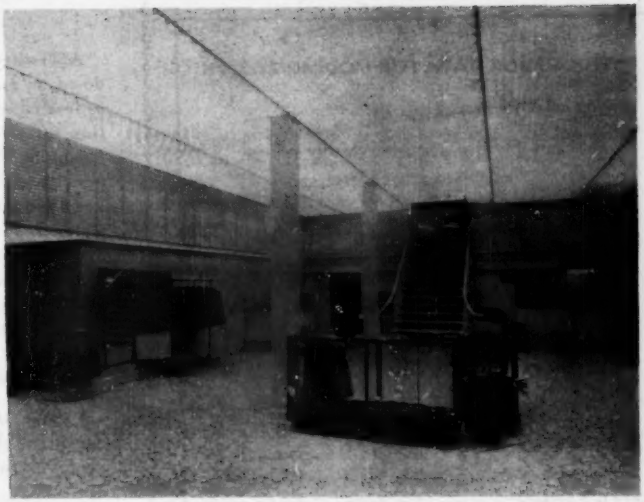


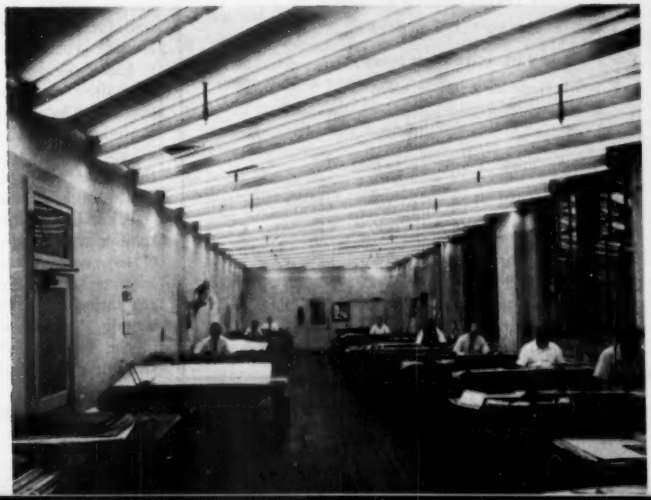
AFTER

MODERNIZATION transformed this cluttered-up, poorly lighted camera shop into an attractive, inviting and well-lighted store. Recessed four-lamp slimline troffers installed on 8-foot centers are used for general lighting. Valances furnish light for wall cases and upper walls along both sides of store. Spots accent special displays at wall or floor cases.

BEFORE

AFTER

DIRECT LIGHTING two-lamp surface type troffers light this drafting room to 80-85 footcandles efficiently. Units are continuous rows, spaced four feet apart, and installed at 45 degrees to tables to minimize shadows from straight edges and triangles. Room was previously lighted with suspended type indirect luminaires.



USEFUL LABOR DATA FOR MODERNIZATION

Drilling holes

(With power tools of appropriate capacity and well-maintained cutting edges.)

Concrete, Hard:

1/4 to 1/2 in. hole	1 in. depth	3.2 hrs. per C
3/4 to 1 in. hole	1 in. depth	6.6 hrs. per C
1 1/4 to 1 1/2 in. hole	1 in. depth	10.0 hrs. per C
2 to 3 in. hole	1 in. depth	24.0 hrs. per C

Concrete Average:

1/4 to 1/2 in. hole	1 in. depth	3.0 hrs. per C
3/4 to 1 in. hole	1 in. depth	6.2 hrs. per C
1 1/4 to 1 1/2 in. hole	1 in. depth	9.6 hrs. per C
2 to 3 in. hole	1 in. depth	22.5 hrs. per C

Brick or Tile:

1/4 to 1/2 in. hole	1 in. depth	1.6 hrs. per C
3/4 to 1 in. hole	1 in. depth	3.3 hrs. per C
1 1/4 to 1 1/2 in. hole	1 in. depth	5.0 hrs. per C
2 to 3 in. hole	1 in. depth	12.0 hrs. per C

Use same unit for each additional inch of depth.

Channeling Chases

(With power tools of appropriate capacity and well-maintained cutting edges.)

For No. 12, 2 or 3 cond. armored cable — **A**
5/8 in. wide by 5/8 in. deep

For 1/2 to 3/4 in. conduit or tubing — **B**
1 in. wide by 1 in. deep

For 1 in. to 1 1/4 in. conduit or tubing — **C**
1 1/2 in. wide by 1 1/2 in. deep

For 1 1/2 to 2 in. conduit or tubing — **D**
2 1/2 in. wide by 2 1/2 in. deep

	Concrete	Brick	Plaster	Gyp. Block	
A	41	20	14	10	Hours per C feet
B	75	37	26	18	Hours per C feet
C	90	45	#32	24	Hours per C feet
D	180	90	#40	45	Hours per C feet

Assuming plaster is not more than 1 in. thick.

Case Study

A 30-story office building was converted from dc to ac and modernized electrically. Original estimated cost of converting service and distribution for an ultimate 60 footcandle lighting intensity and installation of 30 footcandles (maintained) of lighting on 10 floors was $550,000. For 45 footcandles (ultimate), the cost was estimated as 87 percent of the above; 30 footcandles, 73 percent; 15 footcandles, 58 percent. Management chose the 60 footcandle distribution system with 30 footcandles installed on 10 floors. A $692,000 total completed project cost reflected equipment, labor and material price increases during the construction duration.

A percentage breakdown of the cost of various categories of conversion work—typical of most office buildings—was approximately as follows:

Work Category	Percent of Completed Cost
Building motors	6.0
Power circuit wiring	1.0
Distribution (service, switchboards, feeders, etc.)	31.2
Removal of dc equipment, existing lighting fixtures, temporary wiring	4.2
Corridors and public space	0.8

ESTIMATING

Estimating considerations on modernization work are not essentially different from those on new construction. The procedure is the same and much of the labor and material take-off is made in the same way. Modernization work, however, almost always involves structural modification, cutting and patching, adapting to available spaces and the like which are considerably more complex than similar problems encountered in new work.

Electrical plans on modernization are rarely complete and often inaccurate in details essential to accurate estimating. The estimator must visit the premises and develop the plans from his own appraisal of existing conditions.

For rough appraisal of costs on modernization work, the relationships shown in "approximate costs comparison" at the right give a useful approximation.

While no accuracy can be expected in such general relationships as those given in the above table, they check closely with job experience on recent work. The most important relationships are in the labor column. The reputation of modernization work as risky business is largely due to underestimating the labor costs involved in the wholly different environment which the existing structure presents to job management and the job crews.

In Modernization Costs

Building utility areas	0.4
Underfloor duct installation on ten floors	27.2
Fluorescent lighting on ten floors for 30 footcandle (depreciated) intensity	20.5
Provision in distribution for air conditioning	8.7

Design calculations for the feeder system were based on a minimum value of five watts per square foot for lighting and convenience outlets, plus 1½ watts per square foot for air conditioning. Maximum permissible voltage drop was three percent. The complete feeder system with phase balancing panels at each floor, placed special emphasis upon diversity which would vary with the type of tenant and his specific requirements.

Because of existing structural conditions, conduit and cable feeders were most advantageous. Three 500 MCM phase cables with one 350 MCM neutral cable in a 3½-inch conduit created the ideal system and was used throughout for lighting feeders. To handle diversity between different floors (it rarely exists on individual floors in office buildings), a system of parallel feeders serving a considerable area (say three or four floors) was installed. This permitted greater flexibility than single risers serving a smaller area of one or two floors, permitted the use of smaller feeders and circuit breakers.

Cost of lighting ten floors (average of 17,000 square feet each) was $46.30 per luminaire. Fixtures were mounted on 8-ft. centers with ten units per circuit. Above cost included fixture (23.19), lamps, raceways, wiring of fixtures, branch circuit wiring installed in existing home run conduits, installation of new wall switches, plates, wiring for local control and all labor.

Cost of installing 1,250 lineal feet of underfloor triple-duct on a hardwood floor laid on sleepers with a concrete and cinder fill was $5.44 per lineal foot. Cutting through wood floor was accomplished with a Skillsaw using a toothed wheel; through sleepers and fill with a Carborundum wheel.

Cost of installing 2,800 lineal feet of flush-type triple duct, with *after-set* inserts, on a concrete floor was $6.43 per lineal foot. Floor cutting was done with air hammers. To cover the 17,000 square feet of floor area, longitudinal runs of 170 feet were installed on 9-foot centers and connected laterally by means of junction boxes on 17-foot centers.

ELECTRICAL MODERNIZATION WORK

On new construction work, modern buildings are deliberately designed to provide for easy and economical installation of electrical work. Where conflicts occur, they are settled at the planning stage. Often the building is literally built around its electrical wiring system (as when a floor is poured on wiring installed on forms).

In existing buildings, the electrical work must be fitted into available space. The most practical feeder runs, branch circuits, or panel locations in modernization work are not necessarily the most direct or most centrally located. Consequently, materials cannot be applied as economically.

The difference in labor costs between new construction and work in existing but unoccupied premises (B right), is mostly in cutting, patching, working out access to concealed spaces, and fastening exposed work. The extent of this type of work is determined by the amount of structural alterations that are made concurrent with the wiring job. In other words, does cutting and patching have to be done by the electrical contractor, or will much of it be handled by carpenters or masonry trades in the course of alterations?

The steep increase in labor costs when premises are occupied is caused by limited access to working spaces,

APPROXIMATE COST COMPARISONS

		For Labor Costs	For Material Costs
A	Equivalent work in new Construction	$100.00	$100.00
B	Work in unoccupied existing premises concurrent with extensive structural alterations	$200.00	$120.00
C	Work in unoccupied existing premises with little structural alteration	$250.00	$140.00
D	Work in existing premises occupied by owner's employees and where minimum electrical service must be maintained	$300.00	$150.00
E	Work in premises occupied by owner's employees and customers or the general public	$400.00	$170.00

The above materials costs exclusive of lighting fixtures, motors and control or other apparatus.

TYPICAL PERCENTAGES TO BE ADDED TO LABOR HOURS

	For Conditions			
	B	C	D	E
Service	0	0	50	50
Feeder conduit	10	20	30	30
Cabinets	10	20	30	30
Home runs	10	20	50	50
Branch circuits	10	20	100	100
Wire & cable	0	0	10	20
Fixtures	0	0	10	20
Devices	0	0	10	10
Motors	0	0	10	10
Controls	0	0	10	20

need for maintaining service, temporary work, and overtime. Some estimators claim that organizing such work entirely on overtime so that the premises can be considered as unoccupied is most economical.

For effective visualization, the modernization job may be broken down into the following operations:

1. Handling and installing electrical wiring materials and equipment.
2. Extending from existing electrical wiring facilities for new outlets and equipment.
3. Preparation and repair of existing structural features in the course of wiring installation.
4. Problem of carrying out work in occupied premises.

It is evident that much conventional new construction experience data can be applied in the first category, for example:

Conduit, flex or cable work is essentially similar to *exposed work* in new construction.

Surface extensions and special raceways are installed under virtually similar conditions to their installation in new buildings.

Finishing work; panel interiors, wiring devices and fixture hanging takes approximately the same labor units as in new construction.

Take-off

Take-off is somewhat more critical on modernization work because of the importance of taking advantage of access spaces and other structural features in locating runs. Thus, the importance of well developed plans.

Cutting, drilling and similar work is preferably noted with each feeder run or accumulated on branch circuit sheets. The data should then be transferred to pricing sheets and the appropriate units applied.

From the breakdown above, the final listing will include:

1. The electrical installation work listed as in new work with conventional material and labor units.
2. Extension to or re-use of existing features of the wiring system. This material should be listed separately and special labor units applied. No set of units can be applied. Each operation must be visualized by the estimator and labor units developed.
3. Preparation, cutting, drilling and repair of structural features should be listed separately and units applied. A number of useful labor units are given in the accompanying tables.
4. Adders for occupied premises are usually in the form of percentages applied to sheet totals. A few typical percentages are given but they can be only roughly approximate. Proper adders must be developed from the estimator's own experience and judgment.
5. Overtime work should be allowed for in the totals. At least 15 percent should be added to labor hours for decreased efficiency on shift work and the overtime labor rate applied.

A thorough knowledge of all types of electrical materials and distribution methods is an essential to estimating modernization work. For surface extensions and special raceways, a great variety of fittings have been developed to meet different conditions and wiring problems encountered on this type of work. The multiple outlet assembly built into the baseboard can often be used to avoid cutting and patching for receptacle outlets and circuits.

In general, labor units for such installations need only the occupancy adders over similar work in new construction.

Materials

Selection of materials in terms of special installation details can have a significant influence on modernization costs; fixture supports adaptable to installation on existing ceilings, for instance; or box supports designed for use in old work. Make-shift supports are almost always excessively costly in the labor column.

It cannot be too strongly emphasized that modern power driven tools are an elementary requirement in modernization work, particularly in cutting and drilling. If service is not available, it should be provided, by portable generator if necessary. The accompanying cutting and drilling units are based upon the use of power equipment. For hand work the units would have to be increased to several times those given.

The handling of tool costs in the estimate is a subject too extensive for the limits of this article. As a brief summary, however, two methods are in general use:

1. An hourly or daily charge against the job for all power tools assigned to it.
2. A full charge at book value of tools assigned at the time the tool is delivered. Upon completion, the value of the tool is reappraised, a new book value assigned, and credited to the job.

On very large projects, new tools are often purchased for the project and charged to it. At the completion, they are sold and the amounts recovered credited.

From the standpoint of the estimator, the method which insures the best tools in the best condition usually pays off better than attempts at economy in this column, since effective tooling makes for better productivity in the labor columns.

As a general rule, materials removed in the course of the work cannot be economically re-used. The cost of handling and reconditioning and the hidden labor costs of special care in removal to permit re-use can easily become excessive.

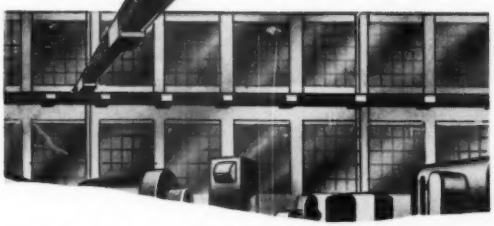
In summary, estimating modernization work follows closely upon the methods and techniques for estimating new construction. The special considerations of work in existing buildings can be separated. In visualizing the work, costs follow the sequence labor, materials, tools and equipment. Costs can be decreased most effectively by reduction of the labor item through critical selection and choice of materials and effective tooling. Case history cost from the files, and a thorough knowledge of the availability of special fittings, tools and equipment provides a sound basis for such selection.

A DIFFICULT ELECTRICAL DISTRIBUTION PROBLEM

SOLVED

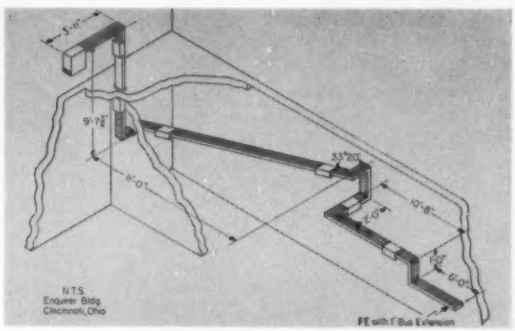
with

NATIONAL ELECTRIC "LO-LOSS" BUSWAY



National Electric "Lo-Loss" Busway answered the need for a new electric feeder capable of carrying 2000 Amperes in The Enquirer Building in Cincinnati. The feeder required for the new service had to travel a circuitous route between existing electrical conduits, busways, steam lines, air-conditioning ducts and building beams. Busway was by far the simplest and easiest way to take care of the job.

National Electric "Lo-Loss" Feeder Bus with insulated copper bars mounted on close centers was found to be ideally suited for the application. Its low reactance, high efficiency and factory-fabricated sections met the job requirement of an easily installed, flexible system that would provide the additional capacity.



"Lo-Loss" Feeder Bus is specifically designed for transmission of electrical current up to 4000 Amperes at 600 volts or less. It's compact in design—easily installed. It's the most economical . . . efficient way to carry electric power (less than 2.2 volts drop per 100 ft.).

Approved by
Underwriters' Laboratories, Inc.
for horizontal or vertical mounting.

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ACCESSIBILITY—Preventive maintenance is simplified because electric circuits are always accessible for a wide range of services at any point along the raceway. The entire wiring layout can be checked before snapping the cover on the wiring channel. When change-overs are made, wiring is accessible merely by removing the cover. On-the-surface raceways can be quickly, easily re-located. Here's preventive maintenance at its best—convenient, simple, quick.

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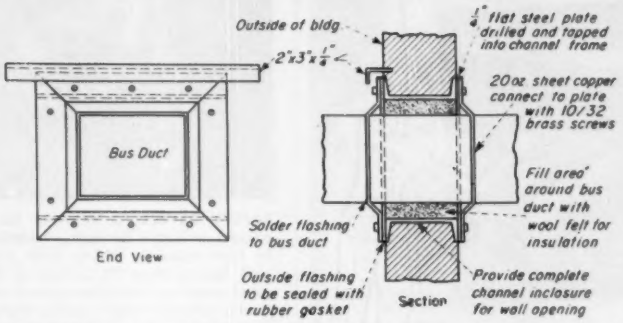
Practical Methods


Outside of bldg
2"x3"x 1/4" ∠
Bus Duct
End View
1/4" flat steel plate drilled and tapped into channel frame
20 oz. sheet copper connect to plate with 10/32 brass screws
Fill area around bus duct with wool felt for insulation
Solder flashing to bus duct
Outside flashing to be sealed with rubber gasket
Section
Provide complete channel inclosure for wall opening

DETAILS of weatherproof and air-tight seal at point where bus duct passes through brick wall. Note copper flashing and felt wool insulation around duct enclosure.

This specific scheme was designed by the engineers to provide a water-tight seal on the duct at the building entrance and to prevent moisture condensation due to temperature differences inside and outside the building wall.

If desired, the air within the duct enclosure could also be sealed off to prevent warm air circulation in the duct and subsequent additional condensation. To accomplish this, sealing compound could be poured into the duct area through a pour and vent hole at the top of the duct. Ebonite barriers around buses in the duct would confine the compound within the wall width dimensions.

Weatherproofing Duct Entrance

WIRING

Several roof substations were installed to serve the electrical distribution system at the assembly plant of the Chevrolet Flint Division, General Motors Corporation. Special Deluxe outdoor type bus duct was used to carry the secondaries from the transformer mat to the main distribution board in an adjacent switchboard room. At the points where the ducts passed through the brick wall of the switchboard room special methods of weatherproofing and insulating the duct section were specified by Albert Kahn Associated Architects and Engineers, Inc., project architects.

As installed by the John Miller Electric Company, Detroit electrical contractors, the method comprised the following operations:

1. A 12-inch channel iron rectangular frame (same width as wall thickness) was fabricated and installed at the time the walls were being bricked up. This formed a "window" through which the duct would pass.

2. A ¼-inch steel plate, fitting snugly around the duct and bolted to the channel frame on each side of the wall, holds the bus duct securely in place. On the weather side of the wall, a ⅛-inch rubber gasket is placed between the steel plate and the channel "window."

3. The space surrounding the duct between the two supporting steel plates and the channel "window" is filled with wool felt insulation to make it air-tight.

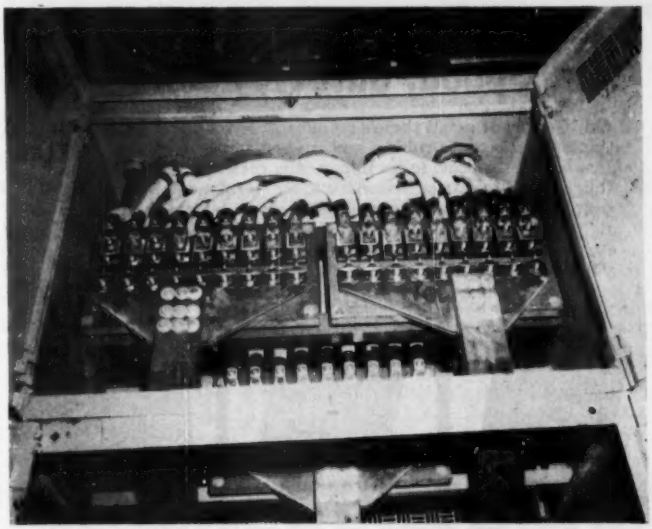
4. A 20-ounce sheet copper flashing is bolted to the outer sides of the steel plates and formed snugly around the duct on both sides of the wall. On the weather side of the wall, this flashing is soldered to the duct housing making a water-tight joint.

5. A length of 2-in. by 3-in. by ¼-in. angle iron, grouted into the wall above the duct window on the weather side, provides a protective canopy above the gasketed steel plate.

Safety Device Prevents Crane Strains

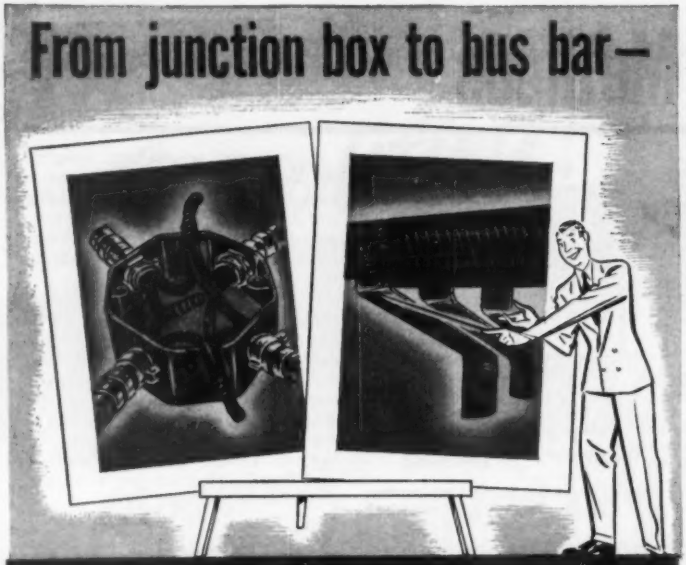
INDUSTRIAL

The safety factor of lifting equipment has been increased at Solar Aircraft's San Diego plant through the use of a new device developed by tooling superintendent Wally Marrow.



FUSE PROTECTION for feeder cables serving main switchboard at Terrace Plaza Hotel Building, Cincinnati, is provided by a 500-ampere link fuse on each 500MCM cable. Nine conductors per phase terminate at fuse blocks above 4,000-ampere incoming breaker. Fuse links connect to copper "fan" plate on phase buses. Similar installation was made on adjoining 4,000-amp. breaker by Bertke Electric Co., Inc., Cincinnati electrical contractors on the project. Eighteen 4½-inch conduits with 54 500MCM conductors feed the two 4,000-amp. breakers from utility vault providing 120/208-volt, 3-phase, 4-wire service.

From junction box to bus bar—



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a mc

SAFETY DEVICE for crane or hoist consists of heavy die spring mounted in steel housing. When hoist lifts load heavier than 95 percent of its rated capacity, compressed spring activates solenoid which applies brake, blocks the crane's "up" motion and makes only the "down" movement operative.

Consisting of a heavy-duty die spring contained in a steel housing on which a solenoid is mounted, it prevents hoists or cranes from lifting more than 95 percent of their rated capacity.

When a load is lifted, the spring is compressed and, to within 5 percent of rated capacity, the electrical circuit for the solenoid remains closed. When this limit is exceeded, however, the compressed spring actuates the solenoid which opens the circuit, applies the brake on the "up" travel and permits only the operation of the "down" mechanism.

The device was designed for use on a 2-ton Shepard-Niles hoist but hoists and cranes of larger capacity can be similarly equipped by increasing the size of the spring and calibrating it to the maximum safe load limit of the equipment.

Fused Plug Aids Testing

TOOL

A simple two-way twin branch plug, having one male screw plug and two female screw plugs, can be utilized by a meter checker or trouble shooter to maintain continuity of service while making a test, according to Myron C. Zeimke, of Oak Ridge, Tennessee.

The male part of the plug is simply screwed into the fuse socket in the branch block or distribution panel, and a fuse plug screwed into one of the twin female screw plugs to provide fuse protection and maintain circuit continuity. A plug and plug cap is then screwed in the other female screw plug, containing a lead of wire to a voltmeter or other metering de-

What they didn't know got me a contract!

"This is no business to fall asleep in! Take what happened to my competitors today. And they're nice fellows too, some of them.

"We've all been after the contract for this new factory. But I knew something they didn't know, apparently. I had found out that in the big feeders, insulated aluminum costs less than copper. Enough less that I could shave my bid. Besides, I figured the lighter weight would save me something on installation.

"OK. That much I knew. But I wanted to be good and sure. So I checked with Alcoa. Their data convinced me.

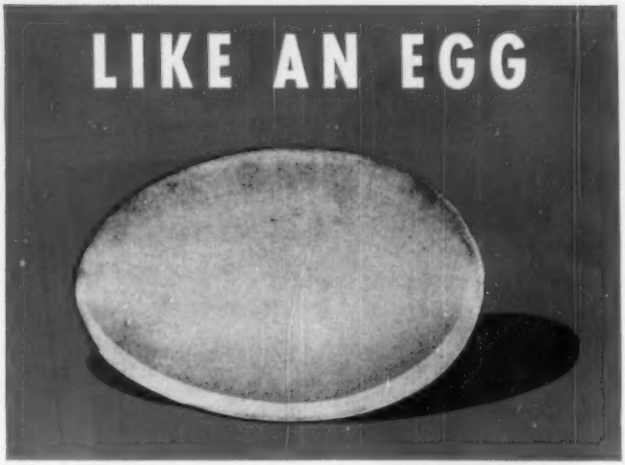
"I was low and I got the contract. Period."

For names of manufacturers and copy of "Questions and Answers About Insulated Aluminum Conductors", phone your nearby Alcoa sales office or write ALUMINUM COMPANY OF AMERICA, 1785G Gulf Bldg., Pittsburgh 19, Pa.

Insulated **Aluminum Conductors**

ALCOA

of ALCOA EC ALUMINUM are made by leading manufacturers



It's What's Inside That Makes the Difference

Looking inside a Jefferson THERMAL Saf-T-Lag Fuse you quickly see the construction features that make *the difference*—in performance, protection and economy.

TRIPLE PROTECTION

JEFFERSON SAF-T-LAG *Thermal* FUSES

Saf-T-Lags provide triple protection. (1) They afford prompt, adequate protection to wiring and equipment against SHORT CIRCUITS. (2) They furnish an extreme accuracy of calibration and a long TIME-LAG that eliminate unnecessary blows on harmless overloads of short duration. (3) Saf-T-Lags also provide THERMAL protection to panel boards and switching equipment thus avoiding damage caused by poor contact, insufficient air circulation or poor heat dissipation.

The use of copper for the link means low watt loss and a cooler operating fuse. The balanced design of the link guarantees equal heat dissipation with no hot spots.

Write for Folder 482-ST and learn why Jefferson Thermal Saf-T-Lags are not just another non-renewable fuse but a triple duty fuse.

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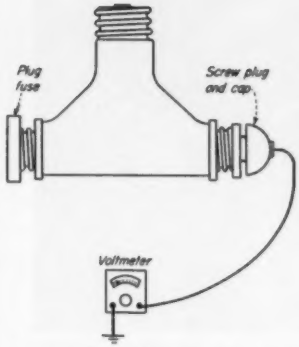


TWO-WAY TWIN OUTLET, with one outlet fused, provides means for maintaining electrical service while making a meter test.

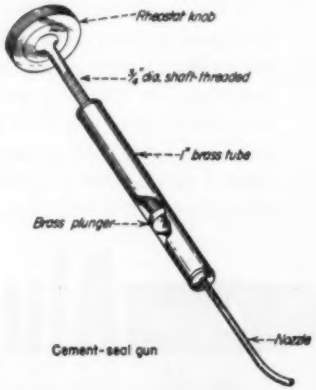
vice, which in turn is connected to a ground by another wire lead. With the fuse still in the circuit, current flows with full protection and the meter tester may be most deliberate in his determination.

Hand Gun For Applying Cement-Seal

MAINTENANCE

One of the chronic problems of electrical maintenance departments and service shops is to determine if someone has been tampering with electrical control adjustments. Evidence of the workings of amateur "screw-adjusters" generally is non-existent.

To preclude tampering with adjustment nuts and screws, a colored radio cement-seal is applied to these parts on the control equipment test floor



HAND GUN for application of cement-seal to control adjustment nuts and screws. Cement forms non-brittle, vibration resistant seal.

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A General Electric Affiliate
PROVIDENCE, R. I.

ALL-IN-ONE SURFACE WIRING UNITS

Save up to 50% on Installation Time for Each Outlet Installed . . . Eliminate Separate Boxes, Devices, Covers, Fittings.

★ **Feed through bus in each device—no splicing, no taping, no soldering. Saves time. Saves 6" to 12" of cable at each outlet.**

★ **Knockouts, when broken out, become sturdy approved cable clamps for non-metallic cable and building wire.**

★ **For BX cable, separate metal clamp secures cable and acts as a continuing ground.**

For Wiring

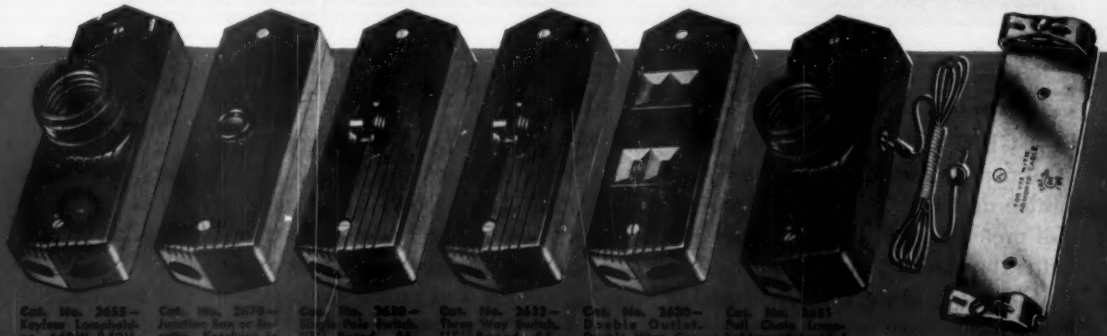
- BASEMENTS
- ATTICS
- GARAGES
- BARNS
- CABINS
- UTILITY SPACES
- ROADSIDE STANDS
- WAREHOUSES
- ANY SURFACE JOB

Wherever conventional surface wiring is used in the city or on the farm, you can cut costs and get a permanent workmanlike job with Monowatt Surface Wiring Units. Made of brown plastic, these all-in-one units are light, tough, durable. Entire group meets Federal and REA Specifications and is approved by Underwriters' Laboratories for use with building wire, non-metallic cable or BX. War-tested in all climates throughout the world, these all-in-one units provide an improved and *job-proved* method of permanent wiring.

BASES MADE FROM ARC-RESISTING UREA COMPOUND

MEET FEDERAL UL R⁴A **SPECIFICATIONS**

EACH OUTLET IS COMPLETELY WIRED WITH ONE UNIT



Cat. No. 2655—Keyless Lampholder. 660W-250V. Meets Federal Specification W-L-142.

Cat. No. 2678—Junction Box or Switch. Knockouts in center connects unit in series. 660W-250V. Meets Federal Specification W-L-131a.

Cat. No. 2630—Single Pole Switch. Rated: 5A-250V; 10A-125V. Meets Federal Specification W-S-896.

Cat. No. 2653—Three Way Switch. Rated: 5A-250V; 10A-125V. Meets Federal Specification W-S-896.

Cat. No. 2620—Double Wipe Contacts 10A-250V; 15A-125V. Meets Federal Specification W-R-131a.

Cat. No. 2681 Pull Chain Lampholder with knotted pull cord. 250W-250V. Meets Federal Specification W-L-142.

Cat. No. 2690—BX Cable Adapter.

Here it is REVOLUTIONARY DEVELOPMENT ..... CIRCUIT

Stab-lok outmodes all popular fusible equipment up to 60 amps!

REGISTRATION APPLIED FOR

"BIGGEST business opportunity in years!" "Outmodes practically all of today's popular fusible devices!" "Safest, most convenient circuit protection at unbelievably low cost!" "No better breaker at any price!"...That's what they're saying about the new STAB-LOK...and here's why:

The STAB-LOK System is simplicity itself. It consists of individual STAB-LOK Circuit Breakers and only 9 STAB-LOK Enclosures. By snapping breakers of the required ampere ratings into the right-size enclosure you can meet practically any circuit protection requirement in seconds.

Not only is the Federal Noark individual pole

THAT WILL *ROCK the INDUSTRY!*

BREAKER PROTECTION AT FUSE BOX PRICES!

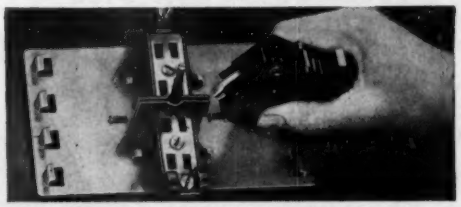
INDIVIDUAL

Stab-lok

CIRCUIT BREAKERS

STAB-LOK Circuit Breakers have a new self-locking plug-in method of breaker insertion. Breaker stabs make instant, positive contact with specially designed busses. Cooperative thermal-magnetic trip action passes momentary current surges but responds at once to shorts and dangerous overloads. Doubly dependable STAB-LOK breakers come in a range of 15, 20, 25, 30, 35, 40 and 50 amperages, single and simultaneous trip double pole.

The combination of matchless protection and low cost in the STAB-LOK System has been attained only by Federal Noark's engineered use of unique developments and by specialized assembly techniques that slash costs.



NEW STAB-LOK SELF-LOCKING PLUG-IN METHOD: You can insert a STAB-LOK Breaker in "no time". Simply put end of breaker under hook and push breaker into place. Stabs make instant contact and are locked in place without using screws.

Single pole STAB-LOK. Its complete metal heart is micromatically calibrated before insertion in case . . . only one solderless terminal . . . automatic reset . . . other unique features.

Double pole STAB-LOK. Its simultaneous trip action assures double pole protection. No handle ties. Only popular priced breaker with this feature.

NEW

Stab-lok

ENCLOSURES

Most of the new STAB-LOK Enclosures are the unique Noark "combination" type for either flush or surface mounting. Each enclosure has an insulated neutral which is groundable on all equipment suitable for service entrance . . . Their capacity range constitutes a complete line that replaces *loadcenters* up to 16 circuits, *panelboards* up to 20 circuits, and fusible *switches* up to 60 amps.

STAB-LOK "FLUSH-SURFACE" ENCLOSURE: "Flush-Surface" Enclosures are delivered with picture-type frame in place and ready for surface mounting. For flush mounting in plastered walls, discard frame and mount box on studding; in dry walls, same procedure except cut hole in wall board to dimensions of inside flange.

STAB-LOK System the most flexible and convenient, it is also the most economical ever devised. STAB-LOK enables you to get CIRCUIT BREAKER PROTECTION *AT FUSE BOX PRICES.* Federal Electric Products Company, 50 Paris St., Newark 5, New Jersey.

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of the Allis-Chalmers Mfg. Co., in Milwaukee. To facilitate application, personnel of the test floor developed a hand gun made from spare parts. With the gun, an employee can place the liquid cement on the nut or bolt one drop at a time. The cement turns into a non-brittle, vibration-resistant solid in air.

The barrel of the gun consists of a short length of one-inch brass tubing fitted with brass plugs held in place by set screws which can be removed to refill the gun. Riding on the inside of the tube is a brass plunger connected to a threaded ¼-in. diameter shaft. An old rheostat knob on the other end of the shaft permits the mechanic to control cement application drop by drop. Small diameter brass and copper tubing soldered together form the gun nozzle.

If the gun is not used for long periods, the plunger may "stick" to the gun barrel, but it can be dislodged by applying a few drops of solvent.

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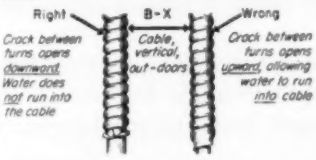
WIRING

Vertical runs of armored lead-covered cable can be installed to exclude the entrance of rain through the spiral flexible sections if the direction of the armor lap is noted and provided for. Since the construction of armored cable is similar to a series of funnels, water can be directed either inward or outward, depending upon the direction at which the water strikes the exterior surfaces. By orienting the cable in a vertical position so that the ascending wrap covers the convolution below it, the water is deflected and runs harmlessly down the outside of the cable. If reversed, water would tend to seep towards the center of the cable through the interstices, with the possibility of rotting wire insulation, creating short circuits and eventually necessitating the replacement of the cable.

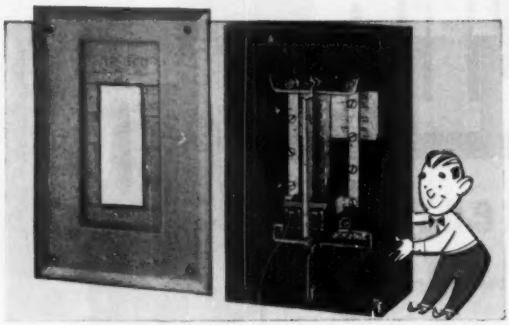

Right
B-X
Wrong
Crack between turns opens downward. Water does not run into the cable
Cable, vertical, out-doors
Crack between turns opens upward, allowing water to run into cable

ARMORED CABLE can be installed so that rain or casual water will run down the outsides harmlessly. This is illustrated by the sketch on the left, where each spiral section covers the edge of the spiral beneath it. When armored cable is reversed, water is directed inwards.

When fast delivery of Panelboards counts—

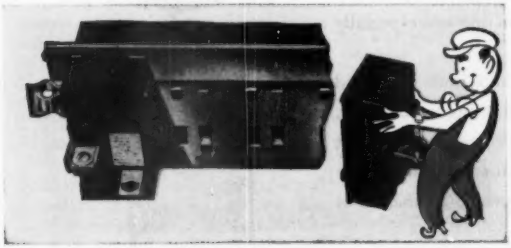
nail down the job with *Pushmatic*® Electri-Centers

Get the jump on every job by stocking minimum supplies of flexible Pushmatic Electri-Centers



1 By stocking a small supply of basic Electri-Centers and fronts plus . . .

2 several boxes of flexible, interchangeable Pushmatics, supplied from your local Distributor, you can make immediate delivery.



3 When you have a rush job, simply pick out the correct basic Electri-Center and hook Pushmatics of the desired ratings and types on the mounting rib and connect them to bus bars with a screw driver.

4 Your Electri-Center is ready for installation! No time wasted tracking down supplies! When time counts—you're prepared for any Panelboard job with a small supply of flexible Pushmatic Electri-Centers!

There's a Pushmatic to meet every load condition: THERMAL ONLY, THERMAL-MAGNETIC, and THERMAL-MAGNETIC with exclusive AMBIENT COMPENSATING FEATURES. All are identical in size and contour, in ratings of 15, 20, 30, 40 and 50 amperes, 1 pole, 120 V., or 2 poles, 120-240 V., AC. All are interchangeable for rating and type.

See your local BullDog Distributor today. He'll be glad to show you how a minimum supply of Pushmatic Electri-Centers will meet every specification and give you the jump on every job.

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***PUSH*—It's OFF!**
***PUSH*—It's ON again!**

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for *added* protection

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PLUGS AND RECEPTACLES • FLOODLIGHTS • TURBO-GENERATORS • CONDUIT FITTINGS • MULTI-VENT AIR DISTRIBUTION

Industrial Electrification

Induction Motors In Industry—Part III

A discussion of ac formulas and definitions, induction motor characteristics and construction features, applications and methods for control.

By G. L. OSCARSON
Chief Applications Engineer
Electric Machinery Manufacturing Company

REDUCED-KVA STARTING

It must be borne in mind that any reduction in starting kva will be accompanied by at least an equal reduction in locked rotor torque and accelerating torque. There is no advantage in specifying a high-torque motor to meet a difficult starting situation and then limiting the starting kva to a value such that reduced voltage starting must be used.

Each design of motor will have a quite definite ratio of torque to kva on starting, and for any given motor design a reduction in kva must be accompanied by a reduction in torque. Thus a Class C motor provides more starting torque per kva than a Class B motor.

Most power companies have quite definite restrictions on permissible starting kva. Common permissible starting methods are the following:

1. Full voltage starting regardless of rating or type.
2. Full voltage starting up to a specified horsepower limit — reduced voltage starting above that value.
3. Starting current limited to fixed percentage of full load current. The method of starting may be full voltage, reduced voltage or other method as long as this stipulation is met.
4. Increment starting. This consists of permitting certain increases in starting current at fixed intervals of time using closed transition between steps; that is, there may be no interruption in current during transfer from one step to the next. This method is commonly used on 120-208 volt network systems and either resistance or reactor starters, part winding starters, or wound-rotor motors are used.

It will be seen (Fig. 15) that the ratio of torque to kva is lower on series-resistor starting than on auto-transformer starting. With series-resistor starting, the kva varies directly as the voltage applied to the motor terminals, and the torque varies as the square of that voltage. With conventional reduced-voltage (auto-transformer) starting both kva and torque vary as the square of the voltage. Also, there is an opening of the circuit in the transition from reduced voltage to full voltage.

The great advantage of resistor starting is that the starting current can be increased in relatively small increments and with no interruption to the circuit. The series resistance may be short-circuited by means of contactors, or in the case of carbon-pile resistors, it may be reduced in large part by the application of pressure.

The terms starting kva and starting current are commonly used interchangeably. With respect to the combination of motor and starter this is satisfactory. Since kva is the product of voltage and current, any change of current, at fixed voltage, means a corresponding change in kva. Since kva per horsepower is used in setting up the NEMA code letters for motors starting characteristics, the term kva is commonly used in all cases. This is true whether kva is expressed as a percentage of full load kva or as a fixed amount.

Connections, torque and kva characteristics vary with methods of starting (Fig. 16) For example:

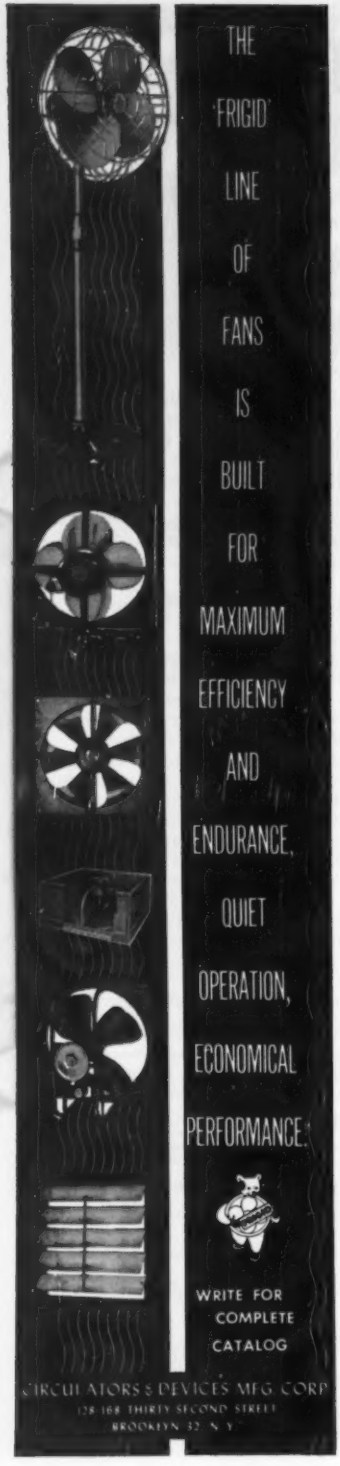
Reduced-Voltage (Auto-transformer) Starting, transferring to full voltage at 75% speed. Dotted line in diagram shows torque available on full voltage. Note that current and torque drop to zero at transfer and that there is a transient current at that point which causes the current to exceed the full-voltage value for that speed.

Closed-Transition (Korndorfer) Starting—Circuit is not interrupted during starting and positive torque is always applied to motor. On second step, part of auto-transformer reactance remains in series with the stator winding.

Series-Resistance Starting — Provides closed transition but has low ratio of torque to kva. Compression type carbon pile disc is sometimes used as resistor element. Series reactor may be used instead of resistor.

	AUTO-TRANSFORMER STARTING			SERIES RESISTOR STARTING		
Voltage Applied to Motor in Percent of Rated Voltage	Line Current in Percent of Motor Locked Rotor Current	Motor Current in Percent of Locked Rotor Current	Locked Rotor Torque in Percent of full Voltage Value	Line Current in Percent of Motor Locked Rotor Current	Motor Current in Percent of Locked Rotor Current	Locked Rotor Torque in Percent of Full Voltage Value
100	100	100	100	100	100	100
90	81	90	81	90	90	81
80	64	80	64	80	80	64
70	49	70	49	70	70	49
60	36	60	36	60	60	36
50	25	50	25	50	50	25

FIG 15—Table shows line current, motor current and locked-rotor torque developed for various values of voltage applied to the stator of the motor for reduced voltage (auto transformer) and series resistor, or reactor starting.



METHODS OF STARTING | FOR SQUIRREL-CAGE INDUCTION MOTORS

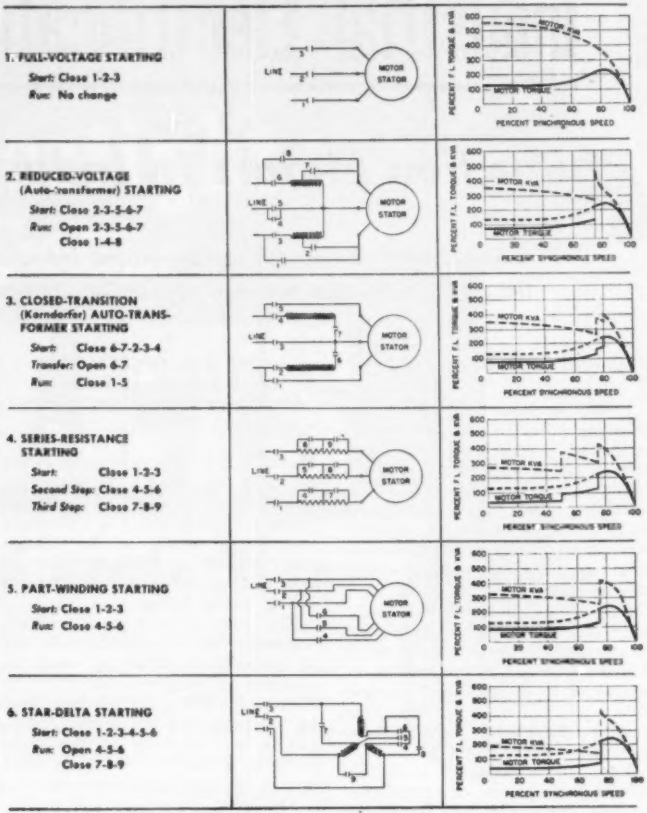


FIG. 16—Circuit connections for various types of starters are illustrated.

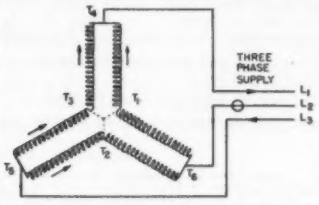


FIG. 17—Parallel-star (high-speed) coil connection for two-speed induction motor. Ends T_1 T_2 T_3 are connected together; T_4 T_5 and T_6 are connected to power supply.

Part-Winding Starting — Stator is wound with two, or more, parallel circuits, which are successively connected to the line. Provides closed transition and has good ratio of torque to kva. Not suitable for small or high speed motors.

Star-Delta Starting — In considerable vogue in Europe but has found little favor in this country, probably due to antipathy of American designers and operators to delta-connected motors. Only necessary starting equipment consists of switches. The motor starts as a star-connected motor and runs delta. This is equivalent to starting on the 57% tap of an auto-transformer.

Multi-Speed Squirrel-Cage Motors —Squirrel-cage motors are essentially fixed speed motors. Variable speed is obtained, however, on group steel-mill roll-out motors by altering the frequency of the power supply. This is done by means of variable frequency generators.

Speed may also be varied over a small range by varying the primary voltage. This can be done for small motors only. It is not practicable for normal industrial applications due to difficulty in dissipating the heat generated by the rotor slip loss.

However, it is readily possible to arrange, squirrel-cage motors for two speeds per winding. As mentioned in Part II, the number of magnetic paths determines the number of poles and thus the synchronous speed. The number of magnetic paths depends on the direction of current flow through the coil groups.

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with exclusive "SPRINGLOX!"

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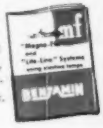

Modern, streamlined lighting of factories and shops may now be obtained with these new Benjamin "Magna-Flo" Systems designed for use with the new Slimline Fluorescent Lamps. In addition to the many advantages of the new, long Slimline Lamps, these new "Magna-Flo" Systems also bring to the user the many cost-cutting advantages of the exclusive Benjamin "Springlox" Lampholders. Now available in single-pin construction for the Slimline Lamps, these exclusive lampholders have proven their advantages over 4 years of trouble-free operation and actual use in more than half a million Benjamin Units.

Benjamin Porcelain-Enameled steel open-end or closed-end reflectors are standard equipment on all "Magna-Flo" Units. Benjamin "Life-Time" Porcelain Enamel brings maximum savings in yearly cost through sustained light-reflecting efficiency, ease of cleaning and durability.

Send for free Catalog Bulletin AD 5705 with complete specifications and other data on the new Benjamin "Magna-Flo" Systems.
Write Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois. 8S175

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Wherever steel or wood must be fastened to concrete, steel or other hard materials there's a spot for DRIVE-IT to save you money. Reports of 75% to 85% savings over old-fashioned methods are common. With Drive-It, a drive-pin plus a power charge does the job in a split-second—and *better* than the old "dig and drill" method.

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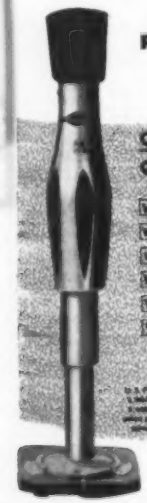
- ☑ Automatic extension barrel



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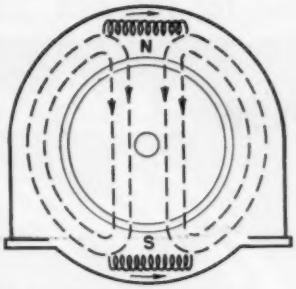

FIG. 18—Parallel-star connection of Fig. 17 provides 3600-srpm speed for a 3600-srpm/1800-srpm two-speed motor.

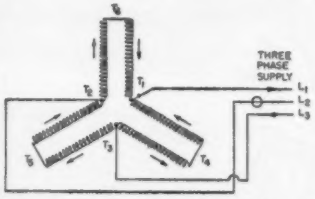

FIG. 19—Series-delta (low-speed) coil connection for two-speed induction motor. T_1 T_2 and T_3 are connected to power supply.

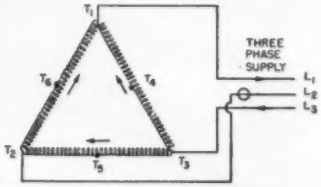

FIG. 20—This diagram is supplementary to Fig. 19 to show the series-delta arrangement of the windings for low speed.

Fig. 17 illustrates a typical parallel-star coil grouping. At a given instant, the direction of current in the coil groups would be as indicated by the arrows. The coils would be grouped and connected as shown in Fig. 18.

This would result in one North pole and one South pole per phase group. The magnetic lines of force would be as shown by the dash line. On 60-cycle service this motor would have a synchronous speed of 3600 rpm.

Now if the internal and external connections are changed to those shown in Fig. 19, this becomes a series-delta connection, probably better represented by Fig. 20. The direction of flow of current causes both coil groups in that phase, to establish South Magnetic poles.

However, for magnetic lines of force to flow from the rotor into the stator (South poles) at both coil groups, they must flow from the stator into the rotor at corresponding points

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TYPE RS*

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For more than 47 years, Century Type RS motors have given satisfactory service throughout the world. They are available in sizes from ½ to 20 horsepower, in drip proof and splash proof frames.

In addition, Century builds electric motors in a wide range of types and kinds—in sizes from 1/6 to 400 horsepower for operation on single and polyphase and direct current. Specify Century motors for all your electric power requirements.

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Wound Rotor Motors—1 to 400 H.P.
Synchronous Motors—20 to 250 H.P.

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Split Phase Induction—1/6, 1/4, 1/3 H.P.
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1/6 to 300 H.P.

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AC, .63 to 250 KVA
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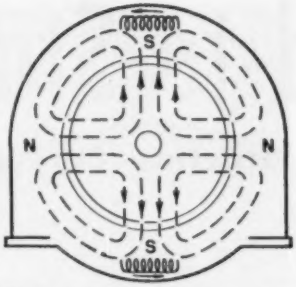

FIG. 21—Series-delta connection of Fig. 19 and 20 provides "consequent" poles to give 1800 srpm for a 3600 srpm/1800 srpm two-speed motor.

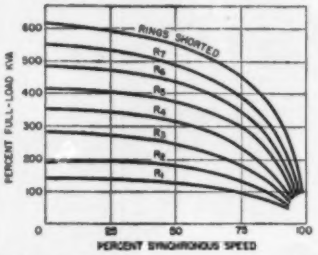

FIG. 22—Starting currents of wound-rotor motor with various steps of external resistance in secondary circuit.

(North poles). North poles formed in this way are called "consequent" poles.

The arrangement is shown as it actually occurs, in Fig. 21. As will be noted, there now exists four poles and the synchronous speed on 60 cycles would be 1800 rpm—half the previous value.

By choice of winding and circuit arrangements, a motor may be designed for two-to-one ratio for either variable torques, constant torques or constant horsepower operation.

By building a motor with two separate windings, each suitable for two-to-one connection, a squirrel-cage motor can be built for four speeds.

Variable-Torque, Multi-Speed Motors are used for loads such as fans and centrifugal pumps.

Constant-Torque, Multi-Speed Motors are used on reciprocating compressors and loads of similar nature.

Constant Horsepower Multi-Speed Motors are used for machine tools. The connections used in Fig. 17 and Fig. 19 are for constant horsepower.

WOUND ROTOR (SLIP-RING) INDUCTION MOTORS

As discussed in Part II, the resistance of the rotor winding has a marked effect on the torque developed at any speed. To develop high starting torque at low starting current, requires a high-resistance rotor. To develop low slip at full load, high operating efficiency and moderate rotor heating requires a low-resistance rotor. The wound rotor (slip-ring) motor is a means of approximating both of these conditions.

The wound-rotor motor has a phase-wound secondary (rotor), having as many poles as the stator winding, connected to slip rings. These slip rings are, in turn, connected to an external resistor. By means of a controller, or a series of magnetic contactors, varying amounts of this external resistance may be shorted out. (Fig. 22)

With all secondary resistance inserted (R_1), approximately full-load starting torque is developed at less than 150% of full-load current. By successively shorting out resistor steps at standstill, up to about 225% of full-load torque can usually be developed on the 4th step. Cutting out additional resistance will then reduce the torque at standstill.

SPEED CONTROL WITH WOUND-ROTOR MOTORS

If the motor in Fig. 24 should be left with only two steps of resistance shorted out, it would continue to operate indefinitely at approximately 65% speed, as the torque developed by the motor equals the load torque at that speed. The heat resulting from the slip loss would be dissipated in the external secondary resistor which, in that case, would have to be designed for continuous duty.

However, if, for some reason, the torque should drop to 50% of full-load torque, the speed would immediately increase to approximately 75% of synchronous speed (following the R_4 torque curve, see Figure 23, until it crosses the 50% torque line).

The wound rotor motor, therefore, is not an exact means of speed control under varying load conditions. That is, a given point on the controller will not necessarily assure a given speed. Torque characteristics of the load will be a factor since the intersection of load and motor torque curves will determine the speed. For a given resistor value the speed can vary widely if load torque, voltage or other conditions vary.

For applications where the wound-rotor motor is used for starting purposes, the collector rings are short-circuited, by the contactors of the secondary control, during normal motor operation. The motor then operates like a squirrel-cage motor with resulting maximum operating efficiency.

However, on some loads having high intermittent peaks of short duration,

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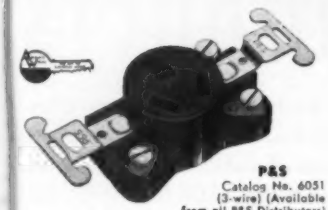

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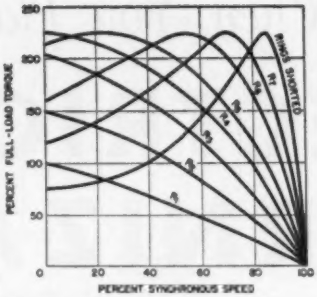

FIG. 23—Torque curves of wound-rotor motor with various steps of external resistance in secondary circuit.

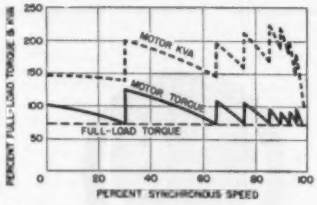

FIG. 24—Showing how secondary resistance of wound-rotor motor can be controlled to provide required torque at various speeds with minimum current.

the motor will be operated with a step or two of resistance cut in. Then at light load the motor operates at nearly synchronous speed. When peak loads are encountered they will cause an appreciable drop in speed. The flywheel effect in the motor and the load will deliver energy during the decelerating period, serving as a cushion between the load and the power supply. Large chipper motors are often operated in this way when their rating is an appreciable part of the power system capacity.

APPLICATION OF WOUND-ROTOR MOTORS

Wound-rotor motors are especially adaptable to compressors, plunger pumps, or other applications started loaded, where high values of starting torque and low starting currents may be required; also where the inertia of the driven machine is high and extremely high slip losses would have to be dissipated in a squirrel-cage rotor in getting up to speed.

Wound-rotor motors are also used on cranes, hoists, elevators, and other similar types of load where frequent starting, stopping and reversing, as well as speed control may be required.

In some cases wound-rotor motors are used where continuous operation at reduced speed is required. Pumps and boiler draft fans are typical applications. In general, speed stability is unsatisfactory below 50% speed. At that speed a wound-rotor motor will develop 40% of full rated horsepower continuously.

Wound-rotor motors have been used in large numbers for operating boiler draft fans. Automatic combustion control is used to actuate the steps of external resistance in the rotor circuit to secure the proper speeds, and dampering is used to regulate air flow between speed steps and below 50% speed.

Wound-rotor motors are also used with either manual or automatic control, to vary the speed of centrifugal pumps and centrifugal refrigerating compressors.

SQUIRREL-CAGE MOTOR CONTROLS

The decision as to the type of starting depends on the conditions of the installation from the standpoints of permissible current inrush from the power system, torque requirements of the load, and whether or not high torque acceleration is objectionable to the driven machine.

For large induction motors Magnetic Control has largely outmoded manually-operated control. The remote control feature permits mounting the starter near the motor, using short motor leads, with small control wires running to the pushbutton station or to pressure switch, float switch or other pilot device.

Full Voltage (Across-the-line or "X") Starters are universally used wherever the line capacity or generating capacity will permit, and where full-voltage torque and acceleration is not objectionable. Full-voltage starting equipment is easiest to install, operate and maintain, and has lowest first cost.

For Low-Voltage Motors. A typical across-the-line starter is provided with under-voltage protection and thermal overload relays. The combination starter provides a disconnect switch, which is obtainable in the fusible or non-fusible type, in combination with the starter.

For Voltages above 600, oil-immersed contactor type control is commonly used.

A control-circuit transformer supplies the low voltage for the pushbutton circuit and the closing circuit of the contactor. In many cases a time-delay undervoltage release type of pushbutton station is used to keep the control energized during momentary voltage dips.

Short-Circuit Protection—In many locations the energy available from the power system in case of a ground or short-circuit is more than can be interrupted by the motor starter. Pro-

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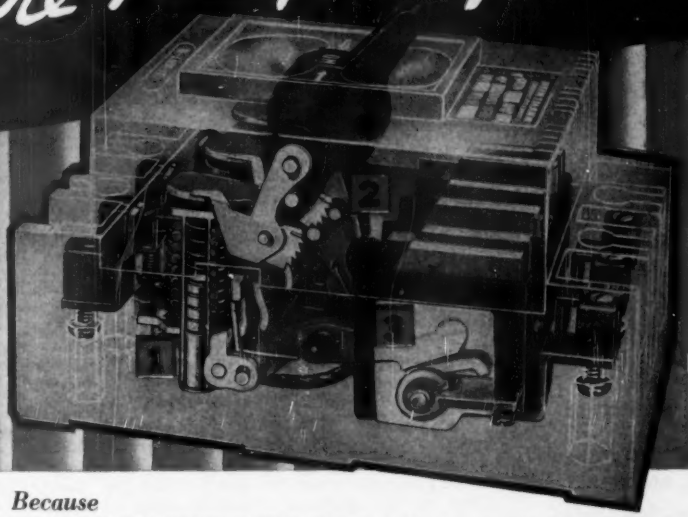

1 *Because* the MAGNETIC-HYDRAULIC TIME DELAY retards the trip unit in time inverse to the magnitude of the current, allowing passage of inrush currents, causing instantaneous breaking on short circuits and delayed tripping on minor overloads. No thermal units, hence NO HEAT generated, no "de-rating" factor needed.

2 *Because* the HIGH SPEED LATCH operated by the trip armature works with minimum friction and maximum speed. It functions only under overload or short circuit conditions, but it does that even if the handle is held in the "ON" position during overload. The rotation of the latch releases contacts which are under heavy spring pressure.

3 *Because* the HIGH SPEED BLOWOUT, through magnetic action, gives instant arc interruption. In multiple breakers the blowout contacts are separated from each other by means of individual arcing chambers. The higher the current, the greater is the quenching effect, due to the intensification of the magnetic field.

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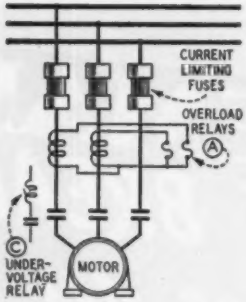

FIG. 25—Elements of short-circuit protection (fuses) and normal operating protection (overload and undervoltage relays) provided in hi-fuse control.

vision must then be made for interrupting the circuit, in case of a fault, without danger to personnel or excessive damage to apparatus. This requirement is met for high voltage motors, with the "hi-fuse" (high-interrupting-capacity, current-limiting fuse control) or high-interrupting-capacity oil or air circuit breaker control.

In the "hi-fuse" control, Fig. 25, current-limiting power fuses are used between the motor switch and the power circuit. These fuses limit short-circuit current to a value that can successfully be interrupted in ½ cycle or less, thus disconnecting the motor and control so quickly as to minimize damage to the motor, and minimize the stresses on the control and the power system. The fuses serve also as disconnects.

Reversing, Across-the-Line Starting for squirrel-cage motors is accomplished by two magnetic contactors or switches, one for forward rotation, the other for reverse rotation. A mechanical interlock is provided to prevent both switches from closing at the same time.

Multispeed, Across-the-Line Starters consist of one or more magnetic contactors or switches for each speed, which respond to pressing the push-button corresponding to the motor speed desired. Overload protection is provided for each speed and the switches are mechanically interlocked to prevent their closing for one speed until they have opened for the other.

Reduced Kva. Starting—A popular, current-limiting starting device for squirrel-cage motors up to approximately 200 horsepower has been the well-known manually operated Compensator.

The Compensator consists of an auto-transformer, providing a reduced voltage for starting, and a switching means by which the operator connects the motor first to the auto-transformer for starting, and then to full line voltage for running. These operations are performed manually by throwing the lever to "start" and then to "run". An interlock prevents throwing the lever directly to "run" so the motor must be started on reduced voltage.

On network systems, typically 120-208 volts, the starting current is usually limited to increments of so many amperes per second. Also, opening the circuit during starting is not permitted. In such cases the resistor type starter is commonly used. This starter uses a resistance in series with the motor windings which limits the current to an acceptable value. At suitable time intervals successive amounts of series resistance are short-circuited until sufficient voltage is applied to permit the motor to start and accelerate. Compression type starters utilizing graphite discs are also used for this purpose. Resistance type starters may be either manually or magnetically operated.

For high-voltage reduced kva. starting, magnetically operated control is generally used.

WOUND-ROTOR MOTOR CONTROL

The wound-rotor motor must have both primary and secondary control.

The primary control is an across-the-line starter of the type, and with protective features as discussed previously for squirrel-cage motors.

The secondary control usually has five to seven steps of resistance. On the first step, with all the resistance in, approximately full-load starting torque is developed with slightly more than full-load current inrush. Additional steps of resistance are short circuited as the motor comes up to speed. The normal operating condition is to short circuit all external resistance.

The secondary control may be either manual or magnetic in operation. The manual controller is the familiar drum type control with operating handle. Moving the handle to the first starting position closes the line contactor through an interlock and places all the secondary resistance across the collector rings. Successive positions short-circuit out the resistor sections.

Magnetic controls are pushbuttons actuated where secondary control is desired only to obtain low starting current and to control acceleration. The contactors which successively short circuit resistor sections may be controlled by timing, current, or frequency relays.

On cranes, hoists, etc., reversing is accomplished by the use of two primary contactors, properly interlocked, one for forward and one for reverse rotation.

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pressors and centrifugal pump installations, the unit is frequently called upon to operate continuously at reduced speed to control output. Magnetic contactors in a special secondary control are actuated by a load control device, and short circuit the proper amount of secondary resistance to secure the desired speed and output.

ADJUSTABLE-SPEED MAGNETIC DRIVE

Wide-range, precision control of speed, using a single-speed squirrel-cage motor rather than a wound-rotor motor can be accomplished with the magnetic drive. This form of precise, adjustable speed is increasing in popularity for fans and centrifugal pumps.

The magnetic drive consists of two elements, the "ring" driven by a constant speed motor, and a "magnet" connected to the load.

The ring of the magnetic drive revolves at the same speed as the driving motor. The magnet, separated by an air-gap from the ring, is free to revolve within the ring. Poles of the magnet are excited by dc through collector rings on the magnet shaft.

Difference in speed between the ring and the magnet results in a cutting, by the ring, of the magnetic flux produced by the magnet. This induces currents in the ring, forming magnetic poles which pull on the poles of the magnet, thus causing the magnet to revolve.

Torque is thus transmitted magnetically through the air-gap between ring and magnet. The amount of torque is varied precisely and over a wide range by varying the excitation of the magnet, to control the speed of rotation of the magnet.

Control of excitation to the magnet of the magnetic drive, and thus control of the speed, is accomplished positively and precisely with an electronic controller. A three-phase 220- or 440-volt supply is rectified and controlled in the "regutron" controller to maintain, adjustable speed requirements.

Output of a small tachometer generator driven from the magnet shaft actuates the "regutron" control to hold operating speed accurately at selected speed. Speed of the load is selected by positioning the arm of a small potentiometer which is actuated by some type of automatic control such as an automatic combustion control for boiler draft fans, or liquid level pilot actuator for pumps. The potentiometer is balanced electrically against the speed-control tachometer, and operates through an amplifier circuit to regulate the output of power rectifier tubes to supply excitation for the required speed of the magnetic drive.

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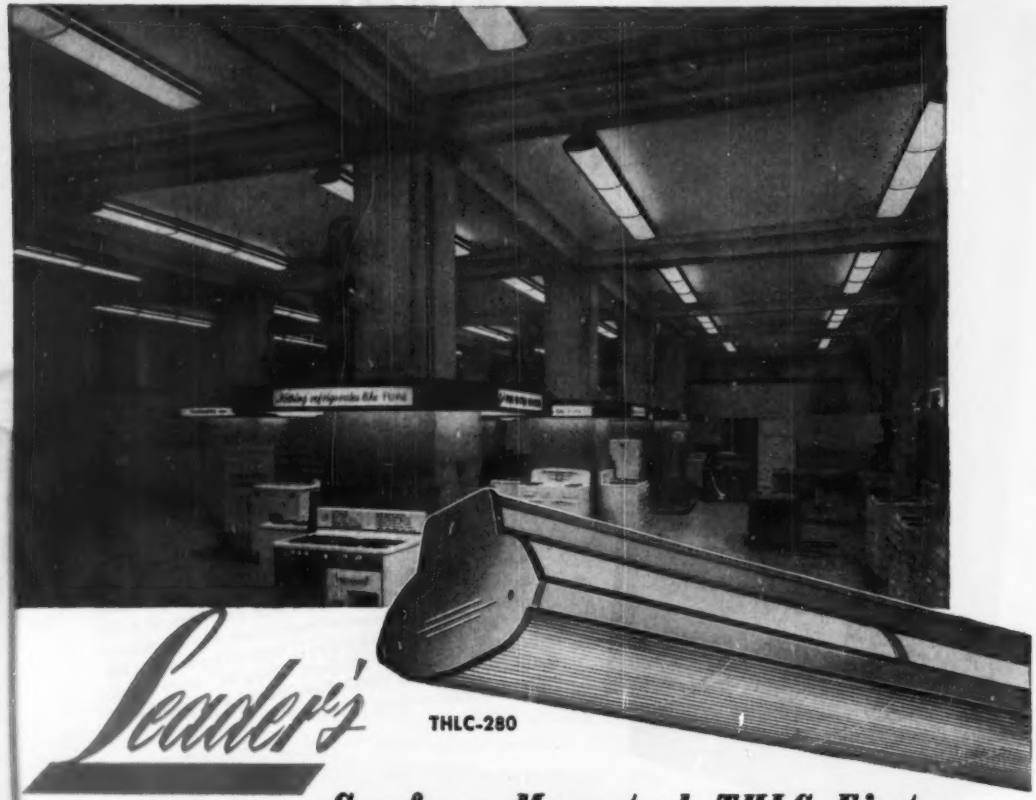

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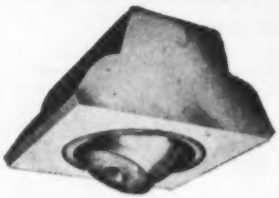

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Modern Lighting

INCANDESCENT LUMINARIES, each using a 1500 watt semi-silvered bowl lamp provide 34 footcandles average in the Home Appliance Display floor, Pacific Gas & Electric Co., San Francisco. Brightnesses (footlamberts) and reflection factors are shown at several points to indicate brightness range.

Incandescent Units Light Salesroom

Incandescent lighting can still be justified for many interiors. Relighting of the Home Appliance Display floor, Pacific Gas and Electric Company, San Francisco, is a good example.

The factors which influenced the selection of incandescent luminaires for the relighting of this large display room area obtain on many relighting projects. The old system of lighting used incandescent luminaires in decorative and outmoded type units. Each unit was equipped with a number of small wattage lamps totaling 1300 watts per unit. The lighting intensity averaged 10.7 footcandles, considered far from adequate to display the modern merchandise effectively.

According to Charles W. Macy, P G & E Lighting Sales Supervisor who planned the new lighting system, the lighting problem was made difficult due to several factors. First, a major modification change for this area was under consideration for some indefinite future date, but some immediate improvement in lighting was imperative, even if it had to be considered as a temporary expedient. Second, no immediate major ceiling changes were permitted and the architectural characteristics of the area were such that modern tubular lighting fixtures were not appropriate. Also, the ceiling was fairly high, and cut up with heavy and deep cross beams forming natural bays. Wiring limited wattage capacity to one 1500-watt outlet per bay, and all modernization costs had to be kept at a minimum.

This lighting problem was solved very satisfactorily by replacing each of the old 1300-watt obsolete incandescent luminaires, one in the center of each bay, with a new, single-lamp, 1500-watt luminaire. The new luminaires used were Silvray No. 1500 S-4R-10, modified as follows: overall suspension was increased from 44 inches to 55 inches; suspension wires between husk and rings or louvers was increased ½-inch; finish was changed to a grey metal coating to withstand greater temperatures; a No. 15LS Louvrille was attached to the center ring; heavier fixture wire was installed to carry increases in load and temperature; and 1500-watt semi-silvered bowl special lamps were obtained for regular use.

The new lighting system, installed with a minimum of cost, provided an average intensity of 34 footcandles. This intensity was obtained at an increase in wattage of only 200 watts per fixture. In other words, the average level of intensity over approximately 1800 square feet was increased from 10.7 footcandles to 34 footcandles with a total increase in wattage of only 1600 watts on the eight units. The downward bright beam effect from the semi-silvered bowl lamps greatly enhances the appearance of the merchandise, and the upward spread of diffuse light from the inside frosted upper part of the lamps provide effective indirect lighting with an evenly lighted ceiling throughout.

Individual Units Light Offices

A highly efficient and effective lighting system, was selected to light the Midtown offices of The Home Insurance Company, New York City. It consists of individual six-foot square luminaires surface installed on the ceiling, one unit to a bay.

Bay areas are approximately 20 feet square, with a 16-foot high ceiling. Bays are formed by columns, and by 14-inch deep beams running between columns in two directions, at right angles to each other. Luminaires were installed in the center of the ceiling areas formed by the beams.

The luminaires are combination fluorescent and incandescent units, and were custom designed and made by Edw. F. Caldwell & Company. Each contains 18 40-watt fluorescent 3500-degree white lamps, and four 150-watt R-40 reflector flood type lamps. Egg-crate louvers are used to shield the fluorescent lamps, and concentric louvers are used to shield the incandescent lamps. The louvers and all interior surfaces were finished white.

The luminaires are only eight inches deep. Exterior curved metal surfaces are painted light cream to match the ceiling, so that they appear to be a part of the ceiling construction. Sidewalls are finished in a light green, with a wood dado of the same color as the desks and furniture.

The fluorescent lamps provide a maintained average intensity of approximately 40 footcandles, and the incandescent lamps provide more than 15 footcandles additional. The total

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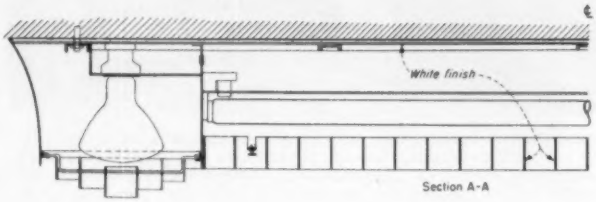
COMBINATION fluorescent-incandescent surface installed individual luminaires provide over 55 footcandles of diffused illumination in offices of The Home Insurance Company, Midtown branch, New York City.



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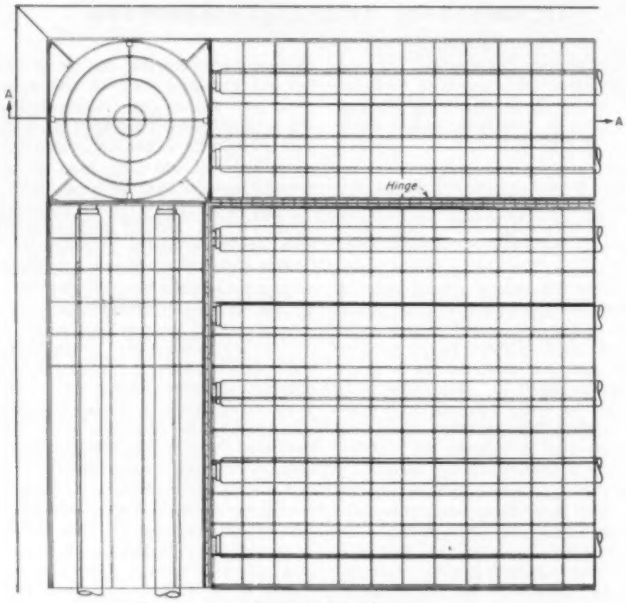
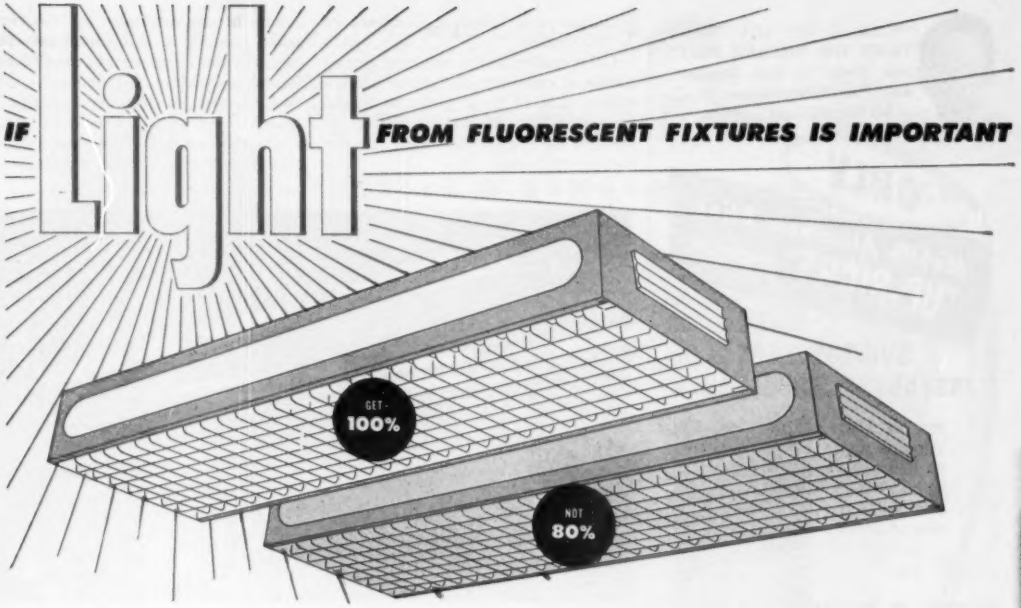


One Quarter Reflected Plan

LUMINAIRES are six feet square and eight inches deep. Each unit contains 18 40-watt fluorescent lamps and four 150-watt R-40 incandescent lamps. Louvers shield the lamps.

IF Light FROM FLUORESCENT FIXTURES IS IMPORTANT



specify... CERTIFIED BALLASTS

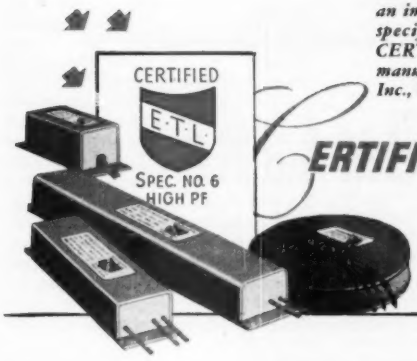
CERTIFIED BALLASTS assure rated light output from fluorescent tubes . . . you get the light you pay for!

Some uncertified ballasts reduce light output by as much as 20%, even though it is not noticable to the eye.

Thus, an installation of 8 fixtures using CERTIFIED BALLASTS would give the same amount of light as 10 fixtures with poor ballasts.

Be sure . . . be economical . . . specify CERTIFIED BALLASTS.

CERTIFIED BALLASTS are made to exacting specifications, then tested and checked by Electrical Testing Laboratories, Inc., an impartial authority, which certifies the ballasts conform to the specifications. Up to the minute information on the types of CERTIFIED BALLASTS available from each participating manufacturer may be obtained from Electrical Testing Laboratories, Inc., 79th St. and East End Ave., New York, N. Y.



CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting

2116 KEITH BLDG., CLEVELAND 15, OHIO

"WOULD NOT SELL IT FOR TWICE THE PURCHASE PRICE" Says Walter G. Kolb, President, Kolb Electric, Washington, D. C., of his first Up-Right Scaffold.

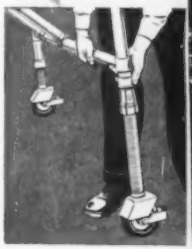
ONLY

Mobile Aluminum Alloy "UP-RIGHT" SCAFFOLDS

have

BUILT-IN LEGS . . . INSTANTLY ADJUSTABLE

for rapid leveling on uneven floors or on stairways. Eliminates the cost of tedious screw leveling.



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MOBILE TOWER SCAFFOLDS

up to 45' or higher assembled in 1 to 15 minutes

EXCLUSIVE FEATURES

That save time & increase profits

MOBILE TOWER SCAFFOLDS in desired number of 6' or shorter section units.

1. Patented one-piece sections — no separate frames. Each section folds flat. No wrenches, wing nuts, bolts or loose parts.

2. Patented casters lock swivel and wheel as one.

3. Welded construction provides greater strength and safety.

4. One man assembly — each aluminum alloy section can be carried and assembled easily and safely by one man.

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Before buying scaffolds insist on a demonstration . . . then buy the best — the one and only . . .

UP-RIGHT SCAFFOLDS

Dept. 107, 1013 PARDEE ST. • BERKELEY, CAL.

Factories: BERKELEY, CALIF., & TETERBORO, N. J.

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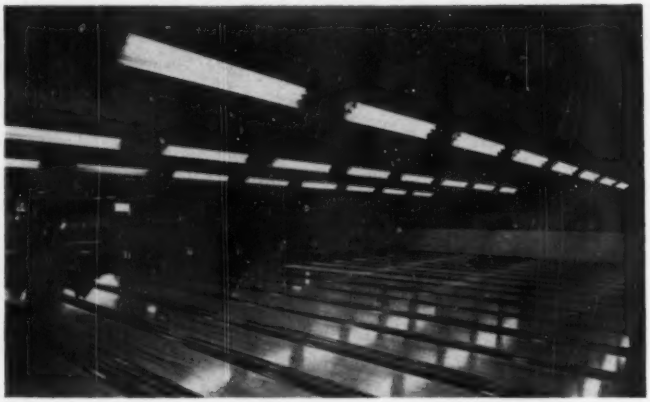
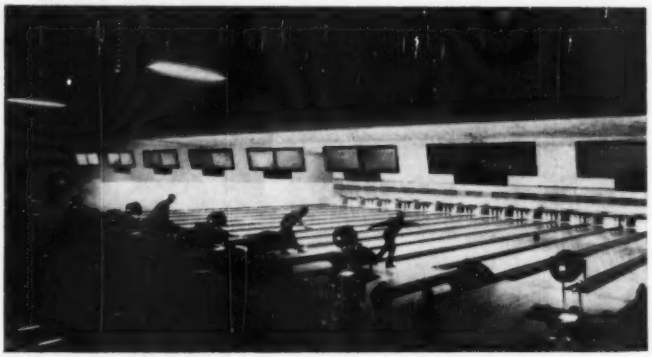
illumination is therefore in excess of 55 footcandles.

Color quality of the resultant illumination is excellent, containing enough yellow rays of light from the incandescent lamps to add a feeling of warmth to the whiter light of the fluorescent lamps.

Use of one luminaire per bay was made possible in this installation because of the large surface area of the luminaires. Light distribution is diffuse, so that the lighting intensity is uniform over the entire work area. Light finished desks and floor aids in further diffusion of the illumination.



LOOKING TOWARDS the foul line, mounting details of industrial fixtures can be noted. Slimline fixtures are mounted behind ceiling beams for complete shielding, and they are tilted in the direction of the pins to direct light away from the eyes of the bowlers. Local lighting illuminates service counters behind spectator galleries.



LOOKING TOWARDS the pins, bowlers have excellent visibility and are not annoyed by any visible light sources. Score pads are illuminated by local units that also project an enlargement of the score sheet to large screens mounted behind the pins, thus informing the galleries of each standing.

Industrial Fixtures Light Bowling Alleys

Industrial fixtures, equipped with twin slimline lamps operating at 200 ma., provide an average lighting intensity of 18 footcandles on the bowling alleys located in the Pomona (California) Recreation Center. Installed by the Hightower Electric Company and designed by W. B. Smith of the Southern California Edison Company, the lighting plan consists of 24 fixtures, mounted 12 feet above the alleys and positioned in three rows with centers 18 feet 5 inches apart. Units are installed at a 45-degree angle to direct the light towards the pins, and they are shielded from the view of the bowlers by protruding concrete ceiling beams. Since consumption of current is 260 watts per fixture and the total area of the Center measures 74 by 98 feet, the installation has a 1.2 watts per sq. ft. electrical load. Fixtures were manufactured by the Sunbeam Lighting Company.

Finish the Job Right

INSTALL A SANGAMO TIME SWITCH

SANGAMO QUALITY ACTUALLY COSTS LESS!

It's sound economy to buy the *best* time switch for your installation. The *overall* cost can be far less, in spite of the slightly higher price. You save labor costs on man hours spent in service calls due to faulty time switch operation . . . you protect the reputation of your work . . . you make satisfied customers who pave your way to increased business!

There's a time switch to meet your exact needs in Sangamo's complete line of *high-quality* time switches. The Type L, for example is a heavy-duty versatile unit for continuous service under even the most severe operating conditions. It can be supplied with a number of control features such as an omitting device, advanced time device, or an astronomic dial for automatic sunset to sunrise operation. All these features are also available on the Type W, which is a switch that does not have to be reset after current interruptions. The Types L, W, and all other high-quality switches of the complete Sangamo line are stocked by your electrical wholesaler.

NEW TIME SWITCH CATALOG . . . Ready for You!

Every Time Switch user will find practical answers to time control problems in Sangamo's new 16 page Catalog No. 1010A. It contains complete information, specifications, wiring diagrams, and prices—everything you need to help you choose the best possible time switch or timer for your next installation. Write for your copy today.

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SPRINGFIELD, ILLINOIS

SANGAMO
Interval Timers

For attic fan and air conditioning control. Type T for wall or switchbox mounting. Type TJ (with plug-in cord) for portable convenience.

VISIBILITY UNLIMITED—

WITH PLEXIGLAS QUALITY LIGHTING

A Lighting Fixture As Big As The Room. PLEXIGLAS diffusing panels in control room of Philadelphia Electric Company generating station. Large sections of white translucent PLEXIGLAS, installed wall-to-wall below cold cathode tubes, give excellent glare-free illumination.

Three things happen when you install PLEXIGLAS Lighting Fixtures:—

Glare and eyestrain take a permanent holiday.
Personnel efficiency and morale go kiting.
Lighting maintenance tumbles to a new low.

White translucent PLEXIGLAS diffuses light so completely that glare simply vanishes. Brightness ratios are remarkably low, yet minimum absorption and maximum transmission of light give full, even illumination throughout any room. Maintenance costs are negligible because PLEXIGLAS is light, strong, shatter-

EYESTRAIN ZERO

No Glare—No Shadows. Installed by Texas Electric Service Co., Fort Worth, in their own sales office, this wall-to-wall luminous ceiling gives glare-free, completely diffused illumination throughout the room. Footcandle reading is 99, *with* diffusing panels—110 *without* panels. This remarkable efficiency is possible only because white translucent PLEXIGLAS absorbs no light. Corrugations run in opposite directions in adjoining panels, providing an interesting decorative pattern. Lighted by 66 T12 Slimlines operated at 425 ma and 107 T8 Slimlines operated at 200 ma.

resistant—proof against discoloration from fluorescent lighting.

Because PLEXIGLAS weighs less than half as much as glass, it's easy to install—even in large sections for wall-to-wall luminous ceilings. And because PLEXIGLAS is easily cut, shaped, machined and fabricated, it adapts readily to coffer, cove or trough lighting, completely enclosed units, wall or overhead lighting of all kinds. For full details of PLEXIGLAS Quality Lighting in banks, stores, drafting rooms and classrooms, send for free literature today. There's no obligation.

WRITE FOR THIS FREE LITERATURE TODAY...
and ask any questions you wish about PLEXIGLAS acrylic plastic for lighting.

PLEXIGLAS is a trade-mark, Reg. U.S. Pat. Off. and in principal foreign countries.

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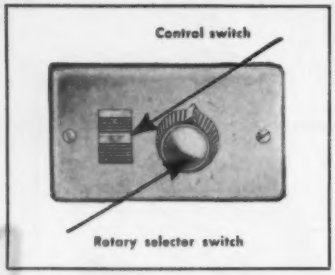
(Advertisement)

WIRING NEWS

A PERIODICAL DIGEST OF WIRING IDEAS FROM THE GENERAL ELECTRIC CONSTRUCTION MATERIALS DEPARTMENT



Master Selector Switch Increases Versatility Of Remote Control!

Here's the newest addition to General Electric's step-saving remote-control wiring system—an addition that affords a wide variety of new applications. Replacing gangs of separate ON and OFF controls, this compact master selector switch provides instant, positive control of *up to 9 different* circuits—and, very simply, too!

To Control Individual Circuits

Turn rotary selector switch to the desired circuit and then press the control switch for ON or OFF.

To Control All Circuits

Merely press the control switch ON or OFF while rotating the selector switch through all nine positions.

Plan to use it for one-panel control of large plant areas . . . for sure, certain emergency light control in warehouses, banks, office buildings . . . for pathway lighting through yards and wharves . . . or wherever else one-point, multi-circuit control is needed.

The G-E master selector fits all standard mountings for flush devices.

Stop in at your local General Electric distributor's and see the entire remote-control system—he'll be glad to demonstrate it for you. Or, if you prefer, check box (A) in the coupon below for complete literature.

Can You Afford To Save On Switches?

Why gamble? Replacements and service calls often cost many times the small savings made on lower-grade switches. So, when *your* plans call for switches, insist on high quality, long-wearing General Electric specification-grade switches.

Free Guide Speeds Box Selection

To make your next layout job an easy, certain one, General Electric offers a free switch and outlet box chart. With this handy specification aid, you'll know at a glance the proper outlet, switch, or utility box for all wiring jobs.

Printed in color and carefully illustrated, this new *Box Buyer's Guide* shows the dimensions of all standard boxes. It gives the number of conductors—by wire size—permitted by the National Electrical Code for the various box sizes and types. And, for easy reference, there's included the section of the National Electrical Code covering box sizes. Send for your copy today—just check box (B) in the coupon.

No Weak Spots in Wet Spots

For wiring in locations where water and dampness present a problem, your best bet is General Electric Flamenol® Type TW wire.

Tough, thermoplastic-insulated General Electric Type TW takes rugged jobs in stride. Use it in raceways or conduit laid in concrete or masonry . . . for machinery wiring in damp or humid atmospheres . . . for conduit installations of all kinds.

Flamenol Type TW is easy to pull, clean to handle. In addition to its flame- and moisture-resistant qualities, the Flamenol insulation is highly resistant to oils, acids, and alkalies.

For more information on Type TW, check box (C) in coupon.

Quality Pays Off In Protection

For locations where severe atmospheric corrosion or moisture is present, G-E white rigid conduit is still the old standby. Made of fine-quality steel, G-E White is hot-dipped galvanized, and further protected by a glass-smooth Glyptal® finish, inside and out.

The carefully controlled manufacture of G-E White provides conduit that is reliably uniform. The interior surface is smooth for speedy wire-pulling. Threads are sharp and clean-cut for easy connection. Consistent wall-thickness facilitates on-the-job threading and cutting.

In interior installation and where not subject to severe corrosive influences, use G-E Black Conduit. On many jobs, G-E Black will give you many economies. Try these two fine General Electric products the next time you buy conduit.

Remember, too, that General Electric supplies a complete line of fittings and accessories. Order them along with your conduit and avoid the costly annoyance of mis-matching and poor-fitting materials on the job. For more information on conduit check box (D) in the coupon.

Tough Cords for Rough Jobs!

Whether it's for a powerful portable saw . . . heavy-duty paint sprayer . . . or light floor waxer—specify "General Electric" on all your flexible cord replacements. You'll appreciate the way G-E cords make it possible to operate equipment efficiently long after other cords become useless.

G-E flexible cords are made in a variety of types and sizes for medium- and heavy-duty use. Look into their advantages the next time you make a cord replacement. For further information check box (E) in the coupon below.

Section K8-718
Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut

Please send me full information on:

- A ☐ Remote-Control Master Switch
- B ☐ Box Buyer's Guide
- C ☐ Type TW
- D ☐ Conduit and Fittings
- E ☐ Flexible Cords

Name _____ Title _____
Company _____
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City _____ Zone _____ State _____

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If you want to know more about something which is advertised in this issue, put the number of the page on which the advertisement appears in one of the squares at the bottom of the card. If you want further information on the product advertised on page 16, for example, just put a 16 in one of the squares. When more than one advertisement appears on a single page, include the manufacturer's initials together with the page number (16-ARB)

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Product News

Multi-Breaker (1)

Announcement has been made of a new "plug-in" multi-breaker panelette as an "off the shelf" companion to the NMO panelboard. It meets ac lighting and appliance circuit switching and protection requirements. Construction features include 12"W by 4¼"D box designed for easy wiring, door with locks, lugs from 4 to 28 circuits, circuit breaker mains from 4 to 20 circuits. Thermal-magnetic "plug-in" units are rated 15, 20, 30, 40 or 50 amperes. They are interchangeable with the NMO panelboard and MO 12 or MO 20 load centers. Available for single phase, 3 wire or three phase 4 wire systems.

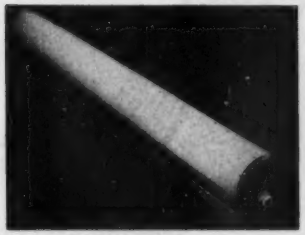
Square D Company, 6060 Rivard Street, Detroit, Mich.

Luminous Ceiling (2)

Announcement has been made of luminous-acoustical ceilings for improved seeing and hearing in classrooms, drafting rooms, offices and other areas devoted to critical visual tasks. Called the Wakefield ceiling, it consists of slimline fluorescent lamps suspended from the structural ceiling slab, supported below which at a distance of about 18 inches are thin translucent corrugated plastic sheets. Suspended below the plastic sheets are perforated acoustical baffles, trapezoidal in cross section and filled with sound absorbing materials. Concealment of pipes and ducts is accompanied by ready availability for maintenance. Simplicity of hanger rod and T-bar chassis arrangement insures efficient ceiling attachment. Lamps in a single installation may be controlled in various combinations to provide different levels of working illumination. Where room design or economics makes it desirable, individual luminous-acoustical panels are available.

The F. W. Wakefield Brass Company, Vermilion, Ohio.

(3)



VAPOR TIGHT FIXTURES for industrial and commercial use has been announced by Paramount Industries, Inc., 823 McFarlan Street, Flint, Michigan. "Twinlight" is for use in dry locations and uses two 20 or two 40 watt fluorescent lamps. The Outdoor model, called "Mariner" is for use in wet locations. It is available in single and twin lamp models using one 20 or one 40 watt lamp and two 20 or 40 watt fluorescent lamps. Approved by Underwriters Laboratories.

Magnetic Starter (4)

A new magnetic starter in sizes to 5 hp., 220 volt ac, 7½ hp., 440-550 volt ac, has been announced. It is furnished with dual voltage coils; with or without built-in pilot controls; and in general purpose or watertight enclosure. The recently developed Switchlet attached to either side of starter provides a means for adding extra circuits.

Furnas Electric Company, 1067 McKee Street, Batavia, Ill.

Explosion-proof Fan (5)

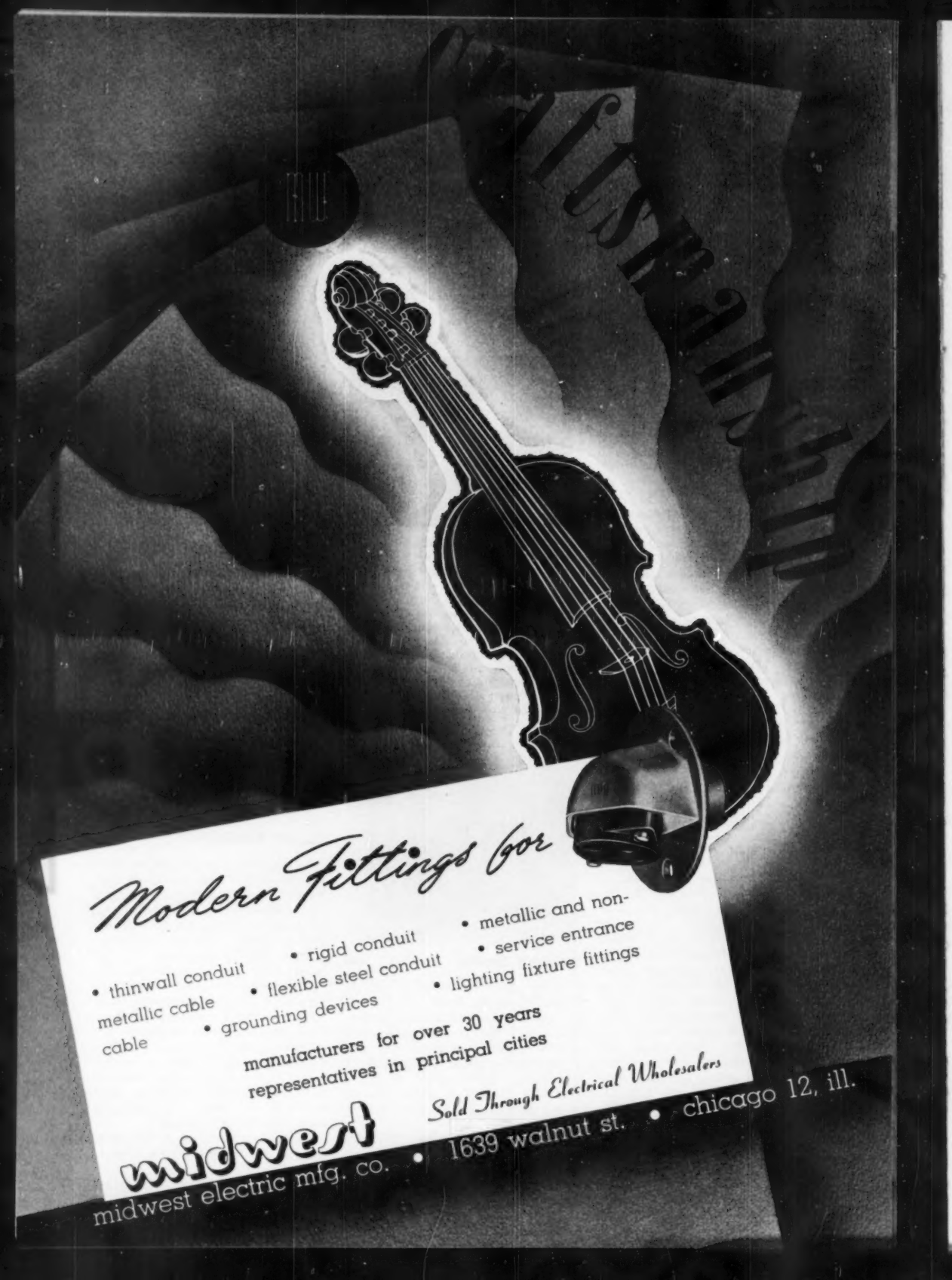
Development of a new series of Type "X" explosion-proof propeller fans for class 1, group D hazardous locations, combining performance features of the Type "Q" propeller fan and ball bearing explosion-proof motor, has been announced. The aluminum Type "Q" propeller fan wheel offers the extra air moving capacity characteristics of this development. Eight models are available with one phase and 3 phase motors. All sizes are suitable for horizontal or vertical operation (fan wheel above motor blowing up). Fans are useful for ventilation in such hazardous places as oil refineries, paint shops, chemical plants, dry cleaning establishments, etc. These same models are suitable for static pressures up to ½ inch, making them adaptable for a wide range of uses.

Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.

Control Rectifier (6)

Development of a new control rectifier has been announced. It offers all weather corrosion prevention for piping systems buried in soil, submerged in liquid or above ground. Features include 8-step voltage adjustment without shutting down unit; high inherent inverse voltage protection; convection cooled rectifier elements have high thermal reserve, no moving parts; automatic high temperature thermostatic cut-out reduces output to half rated value during periods of excessive temperature; seven sizes of rectifier panels fit one dual purpose weatherproof cabinet; and recording meter terminals for connecting recording meter into unit's dc circuit.

Control Corporation, 717 Central Ave., N. E., Minneapolis 14, Minn.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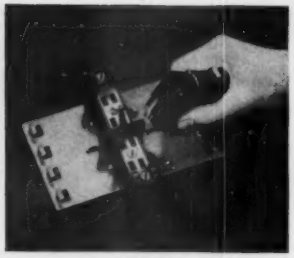
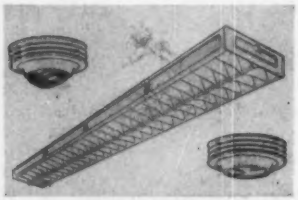


Circuit Breaker (7)

A new line of circuit breakers and enclosures, called Stab-Lok has been announced. Nine enclosures cover requirements from a single pole breaker to a 20 circuit panelboard. Breakers to 50 amperes can be assembled in enclosures by a simple plug-in operation for many combinations. Covers are adaptable to either flush or surface mounting. Breakers are thermal-magnetic. Two pole breakers trip on overload in either side. Terminals are single screw solderless connectors on load side. The makers claim the design provides circuit protection with high measure of safety, dependability and service life at exceptionally low cost.

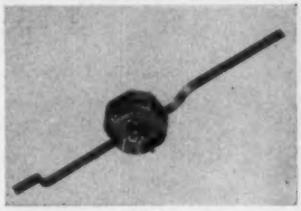
Federal Electric Products Company, 50 Paris Street, Newark, 5, New Jersey.



Lighting System (8)

Plexoline is a lighting system for use in designing modern store and showroom lighting. It is a complete system to form networks of slimline and fluorescent illumination. Three basic units make up the system: 1) Linear sections; 2) Circular accent units; 3) Adapter fittings. Circular accents provide a pivot for the linear sections allowing the formation of any desired angle. It is available in two and four light systems. The 2-light system lists 8′ and 4′ linear sections for slimline and fluorescent lamps and 6′ for slimline lamps. The 4-light systems lists 8′ and 6′ linear sections for slimline lamps and 4′ sections for slimline and fluorescent lamps. Luminous side circular units are available as adjustable accent units or as fixed units equipped with Holophane controlens. Both types are available in two sizes: 15″ diameter for use with 2-light system and 21″ diameter for use with 4-light system. Both sizes of adjustable accent units use 12″ circline lamp and PAR-38 or 46 side prong lamp. The 15″ fixed unit uses one 15-watt lamp while the 21″ fixed unit uses one 200 or 300 watt lamp. Adapters come in two sizes. Linear sections may be surface or suspension mounted. Adjustable "A-J" hangers and twin-stem hangers available for suspension mountings. Surface mounting only is recommended for circular accent units.

Day-Brite Lighting, 5402 Bulwer Ave., St. Louis 7, Mo.



Bar Hanger Box (9)

Completely assembled offset-type bar hanger boxes for both armored and nonmetallic cable installations have been announced. Ease of installation is a feature of this assembly which incorporates heavy-duty two piece stud that assures complete rigidity of box. The stud is easily removed from bar hanger when necessary, and the tightening screw in stud cap is so designed that it will not fall out when stud is removed. The 15/16-inch offset bar hanger is 18 inches in length with three nail holes on one end and one on the other. Bar hanger assemblies with either standard 3½ inch or 4 inch octagon boxes are available.

General Electric Company, Bridgeport 2, Conn.

Instruments (10)

A new line of instruments known as the "Cabinet Series", designed to enable the user to incorporate auxiliary equipment into the case of a direct reading electronic controller has been announced. Contained in a dust and tamper-proof housing and operating with the "electronic link", instruments are used for measurement, indication and automatic control of temperature, speed, flow, pressure, static strain loads, volts, amperes, light density, etc.

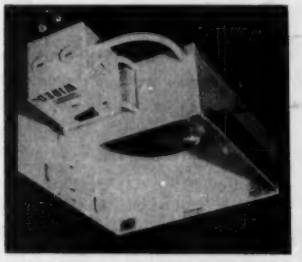
Wheelco Instruments Company, Chicago 7, Ill.

Lamp Base (11)

All bipin-based T-12 fluorescent lamps are now equipped with an improved type of base. Made of permanently lustrous black plastic, the base goes into sockets more easily, and stays in place. Two indexing cone-shaped "bumps" are located on the rounded base edge. When lamp has been properly seated in socket, the "bumps" will be located opposite entrance slots of lampholders. Flanges on base pins are recessed in plastic, and lamps will enter fixtures employing sockets with narrow entrance slots, as well as fixtures whose sockets or holders are mounted with the minimum separate. Vent hole in center of base face allows vapors from alcohol solvent in basing cement to escape during basing operation.

Westinghouse Lamp Division, Bloomfield, N. J.

(12)



RECESSED LIGHTING FIXTURES, No. 488 (100 watt) and No. 1015 (150 watt) 60 centrigrade wire housing, have been announced. A wired junction box is attached, permitting use of standard code grade building wire, Type R, T or TW. These items are offered in three frame finishes: chrome, brushed brass and satin aluminum, with the "relamp-a-lite" feature. Selection may be made from four types of glass: flat alba lite, bent modern sunburst, moulded velva drop bowl, and the fresnel prismatic controlled crystal lens. Manufactured by Pressteel Company, Berkeley, Calif.

WHITER THAN WHITE

ABOLITE DUO-MOVE SYSTEM

The formula for Good Lighting is the combination of proper equipment and simple methods of maintenance. The Abolite Duo-Move System encourages regular cleaning habits because Duo-Move units can be cleaned and relamped quickly and safely without using clumsy ladders. Merely a twist of the wrist—reflector and lamp assembly can be removed and serviced—another turn and it's back in position . . . no interruption to workers . . . no lost time. The Abolite Duo-Move System guarantees maximum illumination with minimum service expense. Write for the Duo-Move story today!

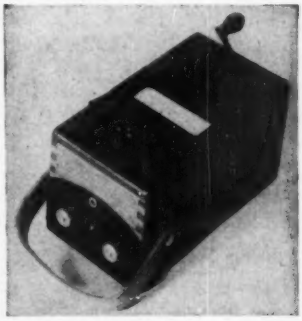
THE JONES METAL PRODUCTS CO.,
West Lafayette, O.

WHITER THAN WHITE
ABOLITE Lighting

Rotameter **(13)**

A new Rotameter has been developed which has the large and two smaller dials reading directly in feet for ½ inch scale plans. For ¼ inch scale, readings are multiplied by two, for ¼ inch scale divided by two. The instrument totals up to 10,000 feet. Button on the stem resets to zero. The instrument is adaptable to measuring conduit and wire runs in estimating and material take-off wherever such measurements are made from scale plans.

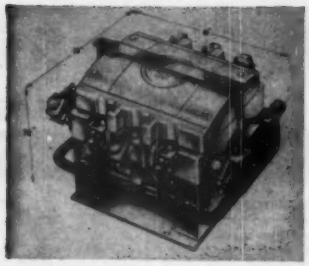
R. A. Koeneman Co., 1408 Delmar Blvd., St. Louis 3, Mo.



Tester **(14)**

A new small, portable, hand crank insulation tester, the "Major" Megohmer, has been announced. Instrument combines small size and weight with constant pressure dc generator and usefulness of unit has been increased by an extra ohm scale. Instrument is built into a teakwood case. Scale is protected by metal flap. It incorporates a true-cross-coil ohmmeter movement which gives direct readings irrespective of voltage variations. Instrument is equipped with guard circuit which prevents erroneous readings in humid atmosphere.

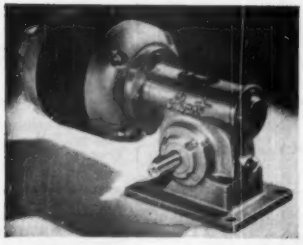
Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y.



Magnetic Starter **(15)**

A new, size 4 "RA" magnetic starter has been announced. It measures 11 inches wide by 10 inches high by 7¼ inches deep. A knee-action bellcrank fulcrum multiplies the leverage and transfers it from a vertical to a horizontal plane. Arc control is obtained by design innovations. The arc is guided across and between quenching and baffle plates, for maximum suppression. High heatproof silicon chutes enclose each contact. Contacts are shaped to form a magnetic "blow-out" field which forces the arc in the correct direction for control and extinction. Terminals are accessible from the top.

Arrow-Hart & Hegeman Electric Company, 103 Hawthorn St., Hartford 6, Conn.



Gearmotors **(16)**

A new line of right angle gearmotors has been announced. Motors are of heavy duty type, NEMA rated. Standard speeds and ratios are horsepower 1/6 to 5; ratios 5 4/5:1 to 100:1; output speeds from 17.5 rpm to 302 rpm. Units can be mounted in any position. Torques are taken by semi-steel gear case. Gears are of nickel bronze. Worms are integral with shaft hardened and precision-ground. Ball bearings are perfectly spaced and neoprene sealed. Insulation is baked varnish. Enclosures drip-proof, totally enclosed, or fan-cooled, optional. Brakes are optional.

Abart Gear & Machine Company, 4835-39 W. 16th St., Chicago 50, Ill.

Operate knock-out punches with HYDRAULIC power

Save at least 60% of the job time!

No Box Distortion • Close quarter operation • Greater Safety • Punches stay sharp up to 6 times longer

Now you can punch conduit openings in electrical distribution boxes, pull boxes, etc., with smooth *hydraulic* power! Yes, punch 'em with ease, up to 4½". Eliminate wrench operation and distortion and loosening of boxes. Work in tightest spots. Use the same "Porto-Power" hydraulic pump and fittings which serve Blackhawk Benders. Save at least 60% of the job time! Order from your supply house today!

A KIT FOR EVERY RANGE— Knock-out punches and the hydraulic ram are available in complete kits serving ½" up to 2" and ½" up to 4½" openings. Hydraulic equipment furnished separately for present owners of hand punches.

ALSO NEW! Blackhawk's big line now also includes a *Thin-Wall Conduit Bender*. Spectacular speed. Get facts on Rigid-Pipe Benders and all new equipment by writing today for Bulletin B-50.

BLACKHAWK

HYDRAULIC *Porto-Power* EQUIPMENT

BLACKHAWK MFG. CO., Dept. P2070, Milwaukee 1, Wis.
Without obligation, rush Bulletin B-50 giving full facts on Blackhawk's entire line of Electrician's Equipment.

NAME.....

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CITY.....STATE.....

Wagner MOTORS--

Wagner Motors are built in a wide range of standard models that includes those types most generally used on motor-driven appliances and equipment, and those types that meet the majority of industrial requirements. They embody the latest developments in design, are simple, rugged and dependable, and have long life in addition to good electrical performance.

POLYPHASE

ELECTRICAL TYPES OF WAGNER POLYPHASE MOTORS

TYPE	RATINGS	CHARACTERISTICS	APPLICATIONS
RP-1	¼ to 400 hp 3- or 2-phase 25 to 60 cycles 110 to 2300 volts	Normal Torque — Normal Slip. Approx. Full-load Slip 3% to 5%.	Group or individual drives on machine tools, fans and blowers, compressors, centrifugal pumps — on any application where normal-torque motors are satisfactory.
RP-5	1½ to 200 hp 3- or 2-phase 60 cycles 110 to 2300 volts	High Torque — Normal Slip. Approx. Full-load Slip 3% to 5%.	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting torque.
RP-6	½ to 150 hp 3- or 2-phase 25 to 60 cycles 110 to 550 volts	High Torque—High Slip. Approx. Full-load Slip 5% to 8% or 8% to 13%.	Punch presses, shears, metal-drawing operations, balers and other machinery equipped with flywheels or having flywheel effect.
RP-7	1 to 60 hp 3- or 2-phase 25 to 60 cycles 110 to 550 volts	High Torque—High Slip. Approx. Full-load Slip 15% to 17%.	Elevators, cranes, hoists, dumbwaiters.
RS-1*	1 to 250 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	Continuous Duty — constant and adjustable varying speed.	Conveyors, compressors, pulverizers, etc., requiring continuous operation.
RS-2*	2 to 200 hp 25 to 60 cycles 208 to 550 volts	Intermittent Service — Crane and hoist duty.	Elevator, crane, hoist, and like services requiring but short periods of motor operation.

The electrical types of squirrel cage motors listed at the left and the multi-speed motors listed at the extreme right may be varied with the types of enclosures listed at the right.

*Wound Rotor Motor

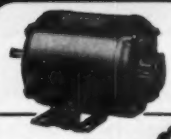
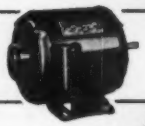
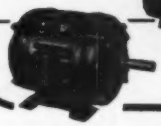
SINGLE-PHASE

DIRECT-CURRENT MOTORS

A companion line to alternating current motors for users in areas served with direct current. 1/20 to 3 hp., sleeve or ball bearing, rigid or resilient mounted, 32, 115, or 230 volts.

GEAR MOTORS

These gear motors combine Wagner motor dependability with nationally-known gear units. The expanded Wagner line of gear motors includes ratings from 1/20 to 50 hp with gear ratios to meet every requirement.

MOTOR DESIGN	TYPE	RATINGS	MECH. VARIATIONS
 Repulsion-Start-Induction	RA	¼ to 15 hp single-phase all commercial voltages and frequencies	Dripproof or totally-enclosed endplates. Rigid, resilient, or flange mountings.
Capacitor-Start-Induction-Run High Torque	RK	¼ to ¾ hp single-phase 50-60 cycles 115 or 230 volts	Dripproof or totally-enclosed endplates. Rigid, resilient, or flange mountings.
 Split-Phase	RB	1/20 to ½ hp single-phase 50-60 cycles 115 or 230 volts	Dripproof or totally-enclosed endplates. Rigid, resilient, or flange mountings.
Fan Motors Shaded Pole	TM	1/125 to 1/30 hp single-phase 50-60 cycles 115 or 230 volts	Totally-enclosed. Round frame, rigid or resilient mounting. 3-speed reactor controller available if desired.
 Repulsion-Induction Motors	RG	1 to 5 hp single-phase all standard cycles and voltages	Open and dripproof. Rigid mounting.

Wagner Electric Corporation EST 1891

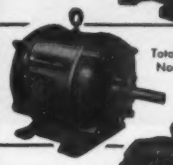
ELECTRIC MOTORS • TRANSFORMERS
INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE PRODUCTS

M30-98

- A COMPLETE LINE...

MOTORS

MECHANICAL TYPES OF PROTECTED AND ENCLOSED SQUIRREL-CAGE MOTORS

TYPE	DESCRIPTION	SIZES
CP	Standard Totally-Enclosed Fan-Cooled	1½ to 200 hp 2- or 3-phase 25 to 60 cycles 110 to 2300 volts
HP	Explosion-Proof Totally-Enclosed Fan-Cooled	1½ to 200 hp 2- or 3-phase 25 to 60 cycles 110 to 2300 volts
TP	 Totally-Enclosed Nonventilated	¼ to 15 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts
XP	Splashproof	¾ to 125 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts

MULTISPEED MOTORS

Multispeed squirrel-cage motors are used where more than one running speed is required, but where close speed regulation is not necessary. They are the same basic design and are available with the same electrical characteristics and types of enclosures as single-speed squirrel-cage motors.

CHARACTERISTICS	SPEEDS	APPLICATIONS
Constant Torque motors have the same torque rating at each speed and the horsepower varies directly as the speed.	2, 3, or 4	Typical applications: lathes, boring mills and other machine tools.
Variable Torque motors have torque ratings which are directly proportional to the speeds and consequently the horsepower varies as the square of the speed.	2, 3, or 4	Typical applications: fans, blowers, centrifugal pumps and similar applications.
Constant Horsepower motors have the same horsepower rating at each speed and the torque varies inversely with the speed.	2, 3, or 4	Typical applications: conveyors, printing presses.

MOTORS

APPLICATIONS
Repulsion-Start Motors — the preferred single-phase motors for every type of application, because of their high starting-torque and low starting-current.
Capacitor-Start Motors — for applications requiring high starting-torque, but whose starting periods are not of long duration.
Split-Phase Motors — for applications requiring low-starting torque, such as unit heaters, oil burners, etc.
Shaded Pole Motors — satisfactory only for applications requiring very small horsepower and very low starting-torque, such as fans directly mounted on the motor shafts.
Repulsion-Induction Motors — intended primarily for the more unusual applications involving a very long starting period and a high starting-torque — such as air compressors starting at very low temperatures.

DRY TYPE TRANSFORMERS

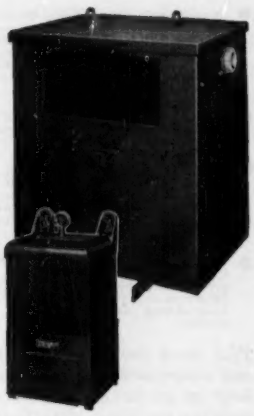
Wagner dry-type transformers are compact and light in weight, easy to install in any location, and easy to move when changes are necessary.

General purpose dry-type transformers are available in ratings from ¼ to 200 Kva, 600 volts and below, single-phase, two coil, type AE and from 3 to 300 Kva, 600 volts and below, three-phase, two coil, Type AP. Type AA autotransformers are also available.

RATINGS 10 KVA AND SMALLER, Type AE, are constructed with endplates clamped over core and coils by through bolts and are designed for wall mounting. These ratings are suitable for indoor or outdoor installation. Listed ratings in this range all bear Underwriters' Approval.

RATINGS 15 KVA AND LARGER, Type AE, are enclosed in ventilated sheet steel cases. These ratings are suitable for indoor installation only. They are normally floor or platform mounted.

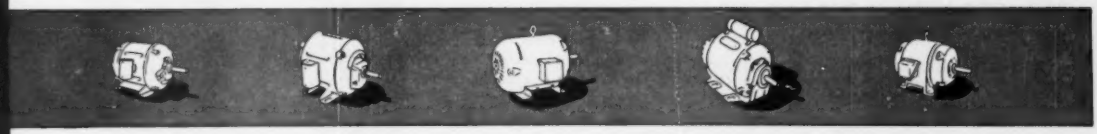
Wagner also builds three-phase dry-type load-center transformers for plant power distribution circuits, in ratings up to 2000 Kva in the 15 Kv class and below.



Bulletins on Wagner Motors, Distribution and Power Transformers will be sent upon request.

Wagner Electric Corporation

6413 PLYMOUTH AVE. • ST. LOUIS 14, MO., U. S. A.



NEW–

A valuable handbook on your D-C equipment

Dusenbery's

D-C MOTOR MANUAL

can help you select and maintain this equipment most efficiently

- This new book provides the information which years of experience have shown to be most useful to the man responsible for the installation and maintenance of modern d-c motors, generators, AND ELECTRONIC CONTROL EQUIPMENT.
- It explains in clear practical terms how each part and circuit works; what type of motor is most efficient and economical under certain operating conditions; the latest methods of installing and servicing each part; how to reconnect motors; how to test for power and losses.
- It contains FULL INFORMATION ON BRUSHES—how to select replacements; how to be sure of proper installation.
- ALL THE LATEST CONTROL EQUIPMENT is fully explained, with complete instruction in the operation and maintenance of the Rototrol, Amplidyne, Maxspeed, Mot-O-Trol, Thy-Mo-Trol systems; rectifier tubes, etc.
- More than 7 pages of MAINTENANCE CHARTS give the symptoms and causes of every conceivable motor trouble or possible failure in any part of the control circuits. Clear wiring diagrams are given for every circuit.

This book can save you expensive and time-wasting breakdowns; can help you get full benefit from today's wonder-working direct current equipment.

SEE IT FREE

The Macmillan Co., 60 Fifth Ave., New York 11

Please send me a copy of DIRECT CURRENT MOTOR MANUAL @ $3.50. I will either remit in full or return the book within 10 days without further obligation.

Signed.....

Address.....

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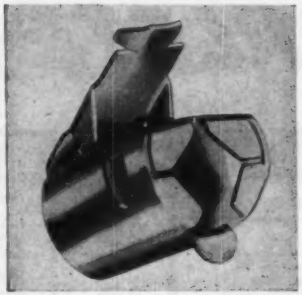


Cable Connector (17)

A new armored and non-metallic sheathed cable connector called Snap X which requires no tools for installation has been announced. It is made of a steel stamping; has a double acting spring clip that holds the cable and grips the outlet box; requires no nuts, screws or locknuts for installation. Cable is inserted into connector body, spring clip compressed and connector snapped in the box knockout. Other features: connector is vibration resistant and easy to stock since two types accommodate cable sizes ranging from two No. 14 to three No. 12 armored of non-metallic sheathed.

Briegel Method Tool Company, Galva, Illinois.

(18)

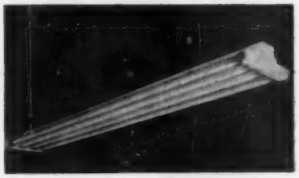
COMMERCIAL FLUORESCENT lighting fixtures, known as Luv-R-Lok series, have been announced by Lighting Products, Inc., Highland Park, Ill. Fixtures are a complete series for 2 or 4 fluorescent lamps in 48 and 96 inch lengths. Each fixture equipped with parabolic plastic sides. Metal cross louvers are held in place by spring locking device. They can be suspension or flush ceiling mounted, individually or joined end to end to give the effect of continuous louvering.

Weatherproof Duct (19)

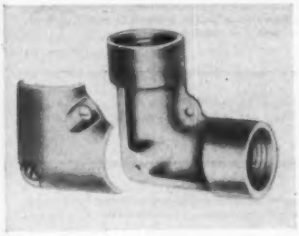
A new weatherproof design of low-reactance feed-in duct which carries the approval and label of the Underwriters' Laboratories, has been announced. Design embodies a complete galvanealed steel enclosure around the standard compact structure to permit installation where exposed to weather or moisture. Suitable drip hoods are provided and enclosure lap joints are positioned to exclude the entrance of rain or dripping water. Duct is available for installation in horizontal runs as well as for vertical risers. Bus bars are separated and totally enclosed by sheets of non-absorptive, arc-resistant insulating material with high dielectric strength. Available in ratings from 600 to 4000 amperes, 600 volts or less.

Square D Company, Roosevelt Park Annex, Detroit 32, Mich.

(20)



FLUORESCENT LIGHTING fixtures for high-ceiling commercial areas have been announced by Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y. The line consists of four units, C-296 and C-496 utilize 8-foot instant start 75-watt T-12 single pin fluorescent lamps. The 4-foot companions, C-248 and C-448, contain the same type 40-watt lamps.



Elbow (21)

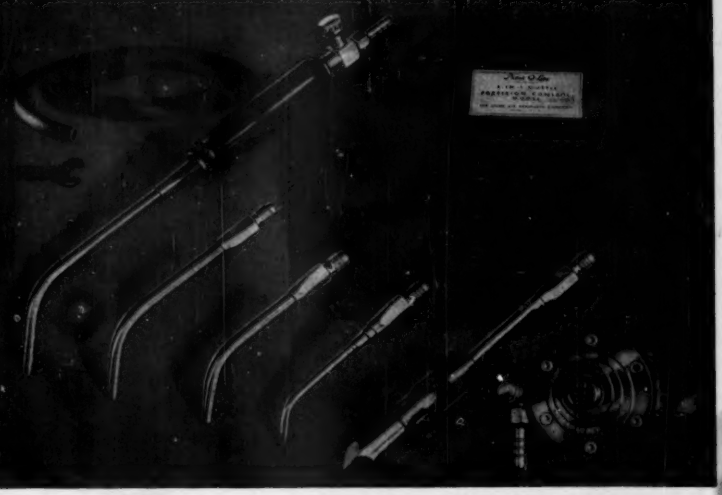
A new pull-in elbow is now available for running conduit around sharp corners without forcing or damaging the wires. It makes sharp right angle turns possible for straddling beams or for any location requiring a snug corner fit. Cover is removable and is located on the side of elbow permitting use on either inside or outside corners. The cover is large and when removed, allows wires to be pulled in straight in either direction. It has been approved by Underwriters' Laboratories, and is available in ½, ¾ and 1 inch sizes.

Gedney Electric Company, 1270 Sixth Avenue, New York, N. Y.

Prest-O-Lite

PRECISION 5-in-1 OUTFIT

One Outfit · Hundreds of Uses



The Handiest Kit in the Shop for SOLDERING · HEATING · BRAZING

FULL WORK RANGE . . . Four stems and a soldering copper cover every air-acetylene job—from heavy soldering or heating to wire splicing or finest work on delicate instruments . . . Slender torch and stems . . . Easy to handle.

PRECISION CONTROL . . . Automatically regulated, constant gas pressure . . . Precise air-acetylene mixtures . . . Torch needle valve for *exact* flame adjustment.

INSTANT FULL-HEAT FLAME . . . No pumping, priming, or warmup . . . Immediate flame temperature of 2,300 deg. F., burning PREST-O-LITE acetylene from a single, convenient small tank . . . No smoke or fumes . . . Unaffected by wind or rain.

COMPACT . . . Handy steel carrying case (7 by 11 by 2 in.) holds entire outfit.

LIGHTWEIGHT . . . Only 5 lb. 13 oz., case included.

5-in-1 Precision Outfit No. 09P84 (illustrated) is furnished with regulator that fits Style B PREST-O-LITE Gas Tanks of 40 cu. ft. capacity. For outfit with regulator that fits Style MC Tanks (10 cu. ft. capacity), order No. 09P85.

Order from Your Local Jobber

Your jobber can show you many time- and money-saving uses for PREST-O-LITE Air-Acetylene Appliances in your work. If you don't know him, write us for his name. The Linde Air Products Company, 30 East 42nd Street, New York 17, N. Y. In Canada: Dominion Oxygen Company, Limited, Toronto.

The term "Prest-O-Lite" is a trade-mark of The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation

Specify

LEVITON

FOR YOUR WIRING REQUIREMENTS

From the simplest receptacle to heavy duty, Type C, T Rated switches . . . specify Leviton. Leviton uniformity, performance, and endurance are worthy of your confidence.

The skill and precision in design and manufacture that go into every Leviton device is part of an unending effort to provide the finest devices that money can buy . . . and to surpass even the highest standards of accepted performance.

5211

5213

5212
5214

The "5000 Series" Combination Devices

No. 5211 Single Pole Switch rated 10A-125V-T, 5A-250V Outlet Receptacle, rated 15A-125V, 10A-250V.

This heavy-duty, switch and double contact receptacle are entirely enclosed in a heavy, sectioned, dustproof, Bakelite housing. Large-head terminal screws, located for side wiring, will hold No. 10 conductors. The + Line side is common to both switch and receptacle, which operate independently. Made in Brown and Ivory.

No. 5213 Single Pole Switch rated 10A-125V-T, 5A-250V. Pilot Light, rated 75W-125V. Same construction as No. 5211. Nickel plated hood removable by slight manual pressure.

No. 5212 Duplex S.P. Switches rated 10A-125V-T, 5A-250V. Same construction as No. 5211.

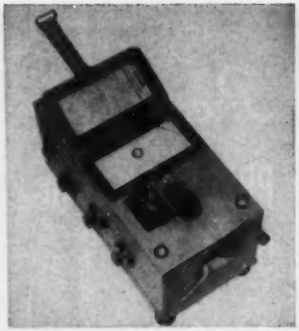
No. 5214 Same as No. 5212 with individual terminals for wiring on separate circuits.

Listed by Underwriters Laboratories and C.S.A. Meets REA and Federal Specifications.

Fits all standard and Leviton duplex wall plates.

YOUR WHOLESALER CARRIES THE LEVITON LINE

LEVITON MANUFACTURING COMPANY
MAIN OFFICE and FACTORY: BROOKLYN 22, N.Y.
WAREHOUSES: CHICAGO and LOS ANGELES



Instrument (22)

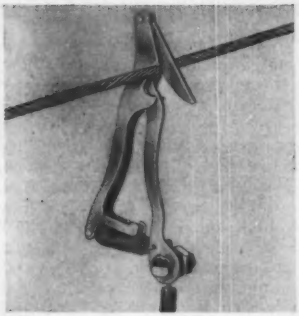
A new high-range Megger insulation tester, up to 50,000 megohms, 2,500 volts dc has been announced. The higher and wider ranges now available are useful in several kinds of field tests, particularly in testing circuit breaker bushings, and in making time-resistance (dielectric absorption) tests on apparatus which has relatively high 10-minute insulating resistance values. The wide range is accomplished by two overlapping scales which results in an 8½ inch scale length. A switch selects between one scale or the other without use of a multiplier or divider.

James G. Biddle Co., 1316 *Arch Street, Philadelphia 7, Pa.*

Exhaust Fans (23)

A line of exhaust fans, 16, 20 and 24 inch sizes, has been announced. Feature of these fans is large capacity for a given blade size. By using deep pitched blade and a large motor, each fan moves a large volume of air. Other features include direct drive, ball bearings of sealed-for-life type, rubber mounted low speed motor of capacitor run type, steel case and metal grill which guards fan blade on inside. All units are two speeds—1100/800 rpm.

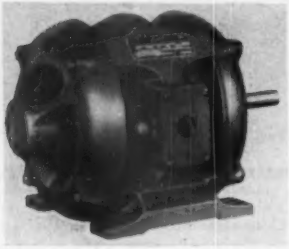
Baldor Electric Co., 4353 Duncan Ave., St. Louis, Mo.



Clamp (24)

A new lightweight Kantfreze clamp incorporates in its design, ease of installation and removal, maximum electrical conductivity and positive clamping. By wedging standard hook stick between legs of clamp, the clamping jaws are opened for installation or removal. Regardless of amount of contraction or expansion of main conductor, the stainless steel spring will exert and maintain high pressure on clamping jaws to assure a positive electrical connection. Clamping members are fabricated from copper. They are available for copper-to-copper connections or the all-purpose clamp, plated, for connections of wires of like or unlike metals.

W. N. Matthews Corporation, 3850 *Delor Street, St. Louis* 16, *Mo.*



Textile Motors (25)

A new line of general purpose textile motors for use where motor is subjected to an unusual amount of lint has been announced. They have rigid cast iron frames and end brackets. Oven cured plastic insulation holds the winding in a rigid mass and encloses the coil ends. Terminal boxes are cast integral with the frame and closed with a steel cover. Mounting feet are cast integral with the frame. Stator and rotor iron is locked and keyed in position under pressure. They are 40°C open rated motors.

Century Electric Co., 1906 Pine St., St. Louis 3, Mo.

Ramset Fastening System

Cost comparison sheet for *General Contractors Inc.*

This form is provided for estimating costs on any job with Ramset Fastening System as compared with present method, and to indicate possible savings with Ramset method.

In estimating fastening time with present system, use actual time of workmen doing the work, including making fastener hole, inserting plug and attaching fastener. Use same method for Ramset, which will ordinarily be less because the fastener itself is set in one operation.

Materials cost for present method should include plugs and fasteners; and for Ramset, should include both fastening charge and the fastener itself.

	Estimated Present Method	Actual Ramset System
NO. OF FASTENINGS	7186	
TIME REQUIRED	2371.4 HOURS	484.3 HOURS
COST AT $ 2.00 PER HOUR	$ 4,742.80	$ 968.60
COST OF MATERIALS	718.60	1,651.68
TOTAL COST	$ 5,461.40	$ 2,620.28
COST SAVED WITH RAMSET SYSTEM		$ 2,841.12
		52 %
SAVED PER FASTENING WITH RAMSET SYSTEM		$ .39
TIME SAVED WITH RAMSET SYSTEM		1887.1 HOURS
		79.5 %

$2,841.00 SAVED WITH Ramset FASTENING SYSTEM

FOUR MINUTES per fastening (total time on job) with Ramset System instead of NINETEEN MINUTES with his old method saved this contractor $2,841.00 on one steel fastening job. Instead of slow, laborious, costly drilling—just load the self-powered, light, Ramset Fastening Tool. Then—READY! RAM! SET! Quick, easy, economical—and tight. *Actual fastening time, less than one minute per fastener!*

Compare *your* fastening costs into steel, concrete and other hard materials. See how much time and money you can save with the simple, lightning-fast Ramset System. With 65 sizes and types of drive pins and threaded studs, you can do almost any kind of construction fastening job.

Your local Ramset Specialist will help you cut costs and show you how to "Ramset" your way into more profitable business. Write or wire us collect for name of nearest representative.

Ramset System

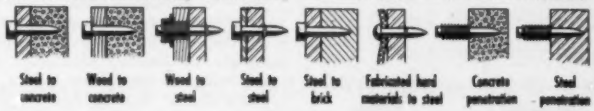
SAVES TIME . . . CUTS COST ON JOBS LIKE THESE:

Fastening—

- Electrical equipment.
- Wiring and conduit.
- Panelboards and controls.
- Lighting fixtures.
- Bus duct and outlets.
- Supports to concrete, brick and steel.
- Television antennae.

Stemco Corporation • Cleveland 16, Ohio

FASTEN FASTER, EASIER, CHEAPER WITH RAMSET



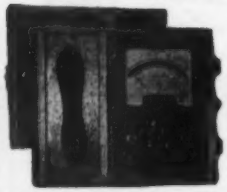
MODEL 247 **Industrial Analyzer**

Only **$28.50 NET**

- Completely portable—No external source of current required.
- Measures VOLTS - WATTS* - AMPERES - RESISTANCE.
- All calibrations printed directly on meter.
  A.C. VOLTS 0 to 150/300/750 Volts
  A.C. CURRENT 0 to 3/7.5/15/30 Amperes
  RESISTANCE 0 to 20,000 ohms
  A.C. WATTS* 0 to 300/750/1500/3000 Watts—115 Volt line
  0 to 600/1500/3000/6000 Watts—230 Volt line

* Watts computed on the basis of Unity Power Factor

MODEL 440 **Insulation Tester**



Only **$44.50 NET**

Quickly & accurately measures insulation leakage from zero to 200 megohms at a test potential of 500 volts. NO HAND CRANKING, built in power supply saves time and effort. A special LOW OHM RANGE (10 ohms center scale) reads as low as 1/10 of an ohm, making possible correct testing of coils, armature windings, etc.

MODEL 420 **Utility Tester**

A.C. Voltage Ranges—
0 to 150 Volts
0 to 300 Volts
A.C. Current Ranges—
0 to 3 Amperes
0 to 15 Amperes
Watts*—0 to 300/1500 for 115 volt line
0 to 600/3000 for 230 volt line
Resistance—0 to 20,000 Ohms

* Watts computed on the basis of Unity Power Factor

Only **$19.90 NET**

The Model 420 will measure the ACTUAL CURRENT CONSUMPTION of electric IRONS - TOASTERS - WASHING MACHINES - RANGES - SUN LAMPS - HEATERS - VACUUM CLEANERS - FANS - AIR CONDITIONERS - REFRIGERATORS, etc. and every type of MOTOR while the UNIT IS IN OPERATION.

TRIANGLE INSTRUMENTS CO.
140 Liberty Street, Dept. "57"
New York 6, N. Y.

TRIANGLE INSTRUMENTS CO.
140 Liberty Street, Dept. "57",
New York 6, N. Y.

Please send ..... Model .....

Name .....

Address .....

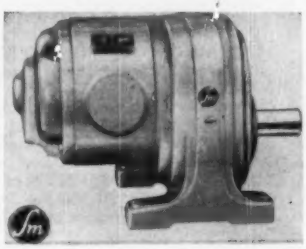
City ..... State .....

☐ Full payment $ ..... enclosed.
☐ C.O.D. plus charges

Lampholders (26)

A new line of porcelain lampholders which will simplify the stocking problem in that one device may be used for either 3½ inch or 4 inch boxes, has been announced. Holes are molded in base for use when mounting on four inch boxes; removable knockouts are provided to permit mounting on 3½ inch boxes. Available in keyless, No. 5228, and pull type, No. 5288 with chain and cord and No. 5287 with chain and insulator. The interiors of pull type being removable are readily attached to even the shortest leads. Leads of ordinary length are attached without removing interiors.

Bryant Electric Company, Bridgeport 2, Conn.



Power Drives (27)

Slo-speed geared electric power drives are now available in the "splash-proof" design for horizontal floor mounting, which is suited for locations which are subject to direct streams of water or other liquids. Motors are built with single or double reduction gears, providing speeds from 780 rpm down to 20 rpm, in ratings ½ hp. to 15 hp. incl. End bell design permits free passage of ventilating air through motor and prevents splashing liquids reaching interior of motor. Seals are incorporated on shaft ends, assuring positive protection against entry of liquids into bearing housings.

Sterling Electric Motors, Inc., Telegraph Rd. at Atlantic Blvd., Los Angeles 22, Calif.

Power Fuse (28)

A new current-limiting power fuse with an interrupting capacity of 100,000 amperes has been announced. Designated Type EJ-6, the fuse is designed for applications on low-voltage circuits where the available short-circuit current is above the operating range of conventional National Electrical Code standard fuses. It is listed by Underwriters' Laboratories and is available in two voltage ratings of standard cartridge fuses, 250 and 600 volts. Both voltage ratings have four basic cartridge sizes—30, 60, 100, and 200 amperes. Typical applications are protection for branch feeders, lighting circuits, combination motor starters, control power circuits, and similar applications where conventional fuses do not have sufficient interrupting capacity. It is available in a variety of continuous current ratings, consists essentially of an insulated tube of melamine impregnated fibre glass having high strength and resilence.

General Electric Company, Schenectady, N. Y.

Outlet Box Anchor (29)

A new and improved anchor for rigidly supporting outlet boxes to wire lath, sheet rock, wall board and other types of dry wall construction requires no tools for installation. Called the Stayput Anchor, the device is stamped from light weight metal; has flanges and long straps for aligning in opening; has indentations in horizontal legs to receive regular No. 4 wood screws spaced to match holes in box flanges. Anchor can be used as template to mark opening and screw holes in wall. Unit is inserted in wall opening, pulled flat against back of wall, straps bent over face of wall after anchor is aligned. Excess strap, for any thickness of wall, can be clipped off after box is mounted.

D. L. Butow Company, 1427 Fowler Ave., Evanston, Illinois.

Advertisement

NOCRETE WITHOUT CONCRETE ENCASEMENT

Orangeburg Fibre CONDUIT NEWS

STANDARD WITH CONCRETE ENCASEMENT

MORE BUSINESS — MORE PROFITS FOR THE CONTRACTOR

VOL. 1 NO. 2 ★★★★★

LEADER AND FIRST CHOICE IN EVERY CITY AND STATE!

NOCRETE for One and Two Duct Installations

For single or double duct runs, ORANGEBURG NOCRETE (Type 2) is the *ideal* conduit. Made with heavier walls for installations *without* concrete encasement, *Nocrete* makes possible valuable savings on such installations as — factories, schools, colleges, hospitals, drive-in theatres, power, telephone and other communications systems — also service entrance, parkway and suburban lighting, airport lighting and communication.

NOW BRANDED WITH ORANGEBURG TRADEMARK

DISTRIBUTED BY

Graybar ELECTRIC COMPANY

LIGHT, EASY TO HANDLE

. . . and *more workable*. That's why Orangeburg Fibre Conduit is a big help in lowering transportation costs and speeding installation.

CUT AND WORKED ON JOB

Orangeburg can be cut with rough tooth hand saw — drilled or worked with ordinary hand-working tools.

Time Defying Materials

Unretouched photograph of Orangeburg material removed from ground after 41 years. Orangeburg withstands ground waters, acids, oils and alkalies.

MORE ORANGEBURG AVAILABLE

. . . at *more distribution* points through Graybar Electric Company and General Electric Supply Corporation.

ORANGEBURG KEEPS FORGING AHEAD

North, south, east and west Orangeburg Fibre Conduit is the first choice of leading utilities and municipalities, many contractors and practically all design engineers. Orangeburg innovated all the important advancements of the fibre conduit industry — another reason why it's the leader.

When the installation requires duct-banks of four or more ducts, ORANGEBURG STANDARD (Type 1) — installed *with* concrete encasement — is the *preferred* conduit.

JUST A TAP OR TWO

Tapered Sleeve Couplings save a lot of time for the Contractor. A few light taps on the coupling drive it firmly against the shoulder of the conduit. This makes a permanently tight, infiltration-proof joint.

Send for Bend Section Folder

Conduit-line transformation problems like this are greatly simplified by Orangeburg Bend Sections. Illustrated folder — showing various types of Orangeburg Bend Sections and Angle Couplings, their specifications, advantages and applications — sent FREE on request. Write today to Dept. EC-7, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

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GENERAL ELECTRIC SUPPLY CORPORATION

ORANGEBURG MANUFACTURING CO., INC., ORANGEBURG, NEW YORK

CPC PLASTIC CLAMPS

"HOLD EVERYTHING"

LONGER • BETTER • SAFER

NON-CORROSIVE STRAP

NO CUTTING EDGES
Thick, pliable. Edges rounded. Far safer if sway or vibration.

FOR ALL TYPES WIRES
Cables, cords, neoprene jacketed wires, romex, telephone, radio entrance cables.

COMPLIES REA REQUIREMENTS
Non-corrosive strap all wet or acid locations

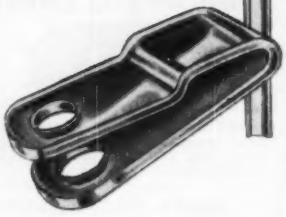
Especially barns

on the FARM

21 SIZES ORDER CPC-742
Safer, Enduring Support. NO SHORTS! NO CORROSION! Safer • lighter • Structurally stable. Endorsed by WPB for Govt. Sizes ⅛" to 1¼"

in INDUSTRY

TV ....ORDER CPC-TV
Perfect control of lead-in Tapes
Only 1 Nail or Screw
Weatherproof
Tough, Pliable, Permanent



. . for the HOME

Write Dept. 27

COMMERCIAL PLASTICS CO.

Merchandise Mart • • • Chicago 54

Brake-Motor **(30)**

The Tri-Clad line of motors is now equipped with Stearns magnetic brakes as unit apparatus. All types of Tri-Clad motors up to 20 hp., 90 lb-ft static torque are available with the explosion-proof, electrically operated brake. The new brake-motor is for application on cranes, hoists, conveyors, machine tools, printing presses, laundry machines, etc. For flexibility, brake combinations are selected to operate at 100 and 150% of full-load motor torque. A single adjustment nut sets the torque for specific load conditions. All brakes, even on open motors, are totally enclosed, and brake cover is sealed to motor housing providing protection from atmosphere, dust and dirt. To safeguard against accidental harm to personnel and equipment, brake will continue to hold even if power fails during operation.

General Electric Company, Schenectady, N. Y.

(31)

ELECTRICAL FIXTURE combining a porch light with illuminated house numbers has been introduced. Known as the Nu-View house number, it consists of a molded bakelite case. Two 15-watt bulbs cast a glow downward, flooding entranceway with soft light. At the same time, light is projected through unbreakable translucent plastic numbers in front of case. A removable base plate makes possible easy installation and replacement of light bulbs and also permits insertion of two, three or four digit numbers. Manufactured by Brittain Products Company, 380 East Exchange St., Akron, Ohio

Instrument **(32)**

A new hook-on wattmeter applicable to active and reactive power measurements in single and polyphase circuits has been announced. Designated as Type AK-2, the device enables measurements to be taken without service interruption. It makes use of a removable magnetic hook to surround the current carrying conductor, and potential leads are connected as in a conventional single-phase wattmeter. Instrument is designed to meet exacting requirements as to accuracy, weight, simplicity of operation, and range of full scale capacities. A selection of any one of six power measurement ranges is available to provide readings from 3 to 300 kilowatts full scale deflection.

General Electric Company, Schenectady 5, N. Y.

Oil Burner Motor **(33)**

A new streamlined fractional horsepower motor of the split phase type, designed specifically for use on oil burners has been introduced. All mounting dimensions of motor are standard, but overall dimensions are reduced to a compact unit. Design of motor makes it easy to clean. It has starting current within the recognized limits. It meets the requirements of Underwriters' Laboratory for oil burner service.

Century Electric Company, 1906 Pine St., St. Louis 3, Mo.

A TERRIFIC HIT!
BETTER MECHANICS PREFER
TOLEDO 1R
THREADER
FOR 1" to 2" PIPE
because
It's ACCURATE!
Perfect threads produced by separate Toledo Dies for each pipe size.
It's EASY THREADING!
Less friction due to famous Toledo receding die principle — small die segments with only a few cutting teeth backed by taper pins.
It's LOW COST!
Simple in design with one ratchet handle.

Do your next 1" to 2" pipe work with a Toledo 1R Threader—the tool that's "tops" with better mechanics! Similar to the famous No. 1 and No. 1A Toledos—but *simpler in design* with one ratchet handle and *low in cost!* A separate set of dies for each size of pipe —1", 1¼", 1½" and 2"—assures longer die life. Each set is hobbed for just the proper clearance. This means easier cutting, smoother, cleaner, more perfect threads and tighter pipe joints! Die change is quick and easy . . . or, many users prefer separate tool for each size. Durable . . . saves job-time . . . reduces costs! Ask your distributor for details and price . . . or send coupon.

RELY ON THE LEADER

TOLEDO

POWER PIPE MACHINES
POWER DRIVES
PIPE TOOLS

SEND COUPON

The Toledo Pipe Threading Machine Co.
Toledo, Ohio

Without obligation, send bulletin No. 650 and price on Toledo No. 1R Threaders, 1" to 2" pipe.

Name.....

Firm.....

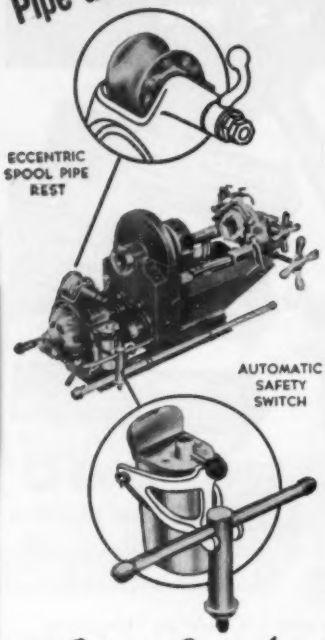
Street.....

City.....State.....

Now Better than Ever

BEAVER Model-A

Pipe and Bolt Machine



Safe! Smoother!

Two new improvements—patents pending—have been added to further increase the safety, convenience and performance of the Beaver Model-A ⅛ to 2" Pipe & Bolt Machine—popular the world over for the past 19 years.

1. The new Automatic Switch Lock and Chuck Wrench holder makes it impossible to start the machine without removing the chuck wrench. This protects both workmen from injury and machine from damage. A highly important Safety Feature.
2. The new Eccentric Spool Pipe Centering Device is detached from the rotating spindle—prevents the whip of long revolving lengths of pipe from rocking the spindle and causing flat-sided, leaky threads.

And don't forget—there are 192 different kinds and sizes of dies available, in stock, for your every requirement when you buy a Beaver Model-A. This die inventory represents an investment of more than $150,000—to insure immediate user service. Sold by leading jobbers—

Write today for new Beaver Catalog No. 50. Address Beaver Pipe Tools, Inc., 222-388 Dana Avenue, Warren, Ohio, U.S.A.

50 Years of Friendly Service

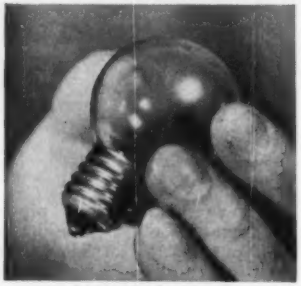
BEAVER PIPE TOOLS

Woven Wire Slings **(34)**

Announcement has been made that woven wire slings are now available in standard widths of 3 to 30 inches and from 36 to 132 inches standard lengths. Slings are constructed from an adaptation of a basic mesh used in the fabrication of Cambridge woven wire conveyor belts. They are available in any metal or alloy, including stainless steels. Special tempered steel handles, attached to both ends of sling itself, permit use of either a choke or basket hitch around material being handled.

Cambridge Wire Cloth Company, Cambridge, Md.

(35)



SMALL LAMP BULB, less than 1½ inches in diameter for dispelling unwanted odors has been introduced. It operates on household current, and is used with a ballast in a simple fixture which allows the free escape of ozone, but shields eyes from ultraviolet energy generated by lamp. Bulb is expected to find use in many cases where a deodorizing effect is desired. Manufactured by General Electric's Lamp Department, Nela Park, Cleveland 12, Ohio

Product Briefs

(36) Announcement of a new small wire **terminal block** has been announced by the Curtis Development & Mfg. Co., Milwaukee, Wis. . . . (37) The American Coach & Body Company, Cleveland, Ohio, has introduced a new hydraulic aerial revolving ladder.

(38) Dickson Engineering & Sales Co., Minneapolis, Minn. has developed a new type of electrical **soldering iron,** known as "Vari Hot". . . . (39) Syntron Company, Homer, Pa. has introduced a new line of selenium metallic **rectifiers**. . . . (40) An all-purpose line of alumalloy **traffic signals** and accessories is being produced by the Killark Electric Manufacturing Company of St. Louis, Mo.

(41) A new ready-to-install neon-type **pilot light,** designed for switchboards, instrument and other panels, has been announced by Industrial Devices, Inc., Edgewater, N. J. . . . (42) Wilson-Albrecht Co., Inc., Minneapolis, has added the Waco **swing stage** to its line of scaffold jack and rolling towers. . . . (43) Electro-Mechano Co. of Milwaukee has announced a new portable electric **tachometer.**

(44) The development of a new waterproof all-weather outdoor **floodlight holder** has been announced by the Mattox Machine Company, Los Angeles, Calif. . . . (45) U-C Lite Manufacturing Company, Chicago, Ill. has introduced a new big beam junior, Model No. 111, portable **electric hand lamp**. . . . (46) Irvington Varnish & Insulator Company, Irvington, N. J. has developed a new No. 123 **insulating varnish** which stays flexible after baking.

(47) Dresser Electric Co., Detroit, Mich. has announced a marine **rectifier** for charging batteries on boats. . . . (48) The Delbridge Calculating Systems, Inc., St. Louis, Mo. has developed a combined social security and withholding **tax chart**. . . . (49) Unimatic Corporation, Nutley, N. J. has announced a new series of Harbot **connectors** designed for use on curved surfaces, castings and other installations where there are variations in wall thickness.

(50) A new rust inhibiting **oil base paint** has been added to the list of maintenance products offered by United Laboratories, Inc. of Cleveland, Ohio. . . . (51) Lindell Electric Company of Minneapolis, Minn. has introduced a new Model 32 **boring tool** for boring holes in wood joists and studdings. . . . (52) The Rockford Wire Stripper Co., Rockford, Ill., has announced a new Whiz **wire stripper.**

(53) The A. W. Haydon Company, Waterbury, Conn. has announced a new line of standardized ac **timing motors**. . . . (54) Burlington Products Company, Burlington, N. J. has announced **Saf-Gards,** which are electric outlet shields to protect children from shock. . . . (55) Industrial Devices, Inc., Edgewater, N. J. has introduced a new **plug body,** which is a nylon housed screw-type electrical receptacle designed primarily for industrial uses.

Sub-Stations and Power Centers

Dry-Type

Engineered to meet **for indoor installations**

Your Exact Requirements

Not necessary to design or change your installation to fit a "standard"

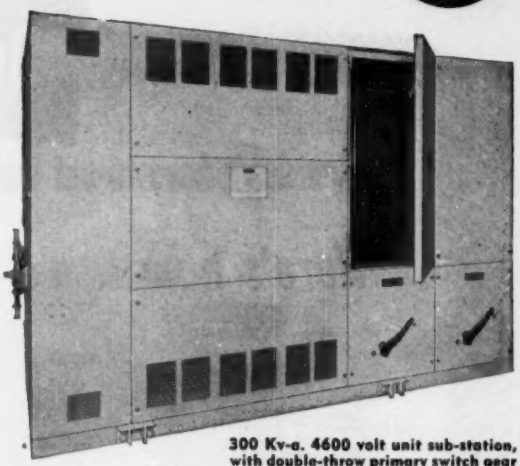
Any type of primary switch gear.
Metering—primary or secondary, to suit.
Secondary breakers, main, branch, or tie.

Interlocked or automatic throw-over. Draw-out or stationary types. Magnetic trip, or thermal, or combination. All incorporated with high quality, liberally designed

Sorgel Air-Cooled Transformers

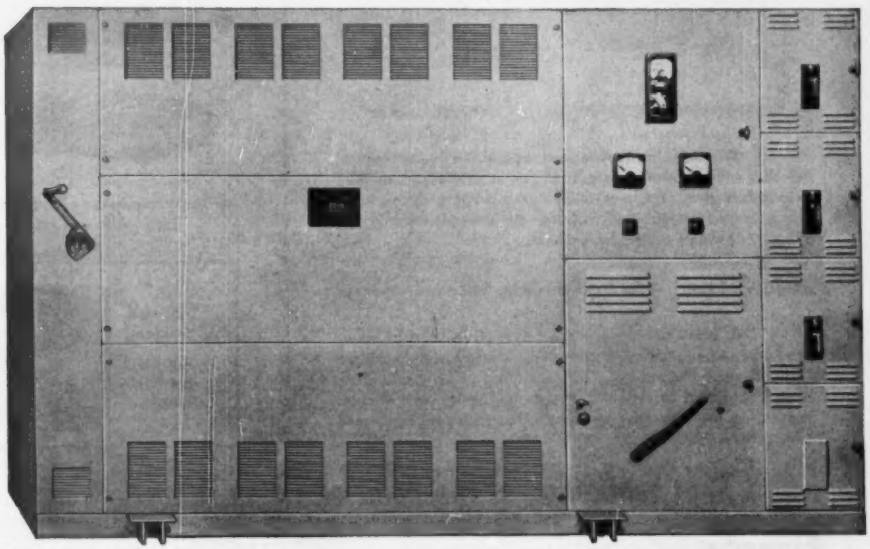
All factory wired, tested and assembled. Mounted on a substantial steel base. Shipped as a single unit or in sections, accurately co-ordinated for easy assembly on the job.

Sizes up to 2000 Kv-a. All voltages up to 15 KV.



300 Kv-a. 4600 volt unit sub-station, with double-throw primary switch gear to obtain emergency service from more than one source. Secondary main and tie breakers interlocked to obtain secondary service through another unit. Thermal type branch circuit breakers.

Send for new bulletin 450



1500 Kv-a. 13,200 volt unit, with primary disconnect, secondary metering, main and branch circuit breakers.

Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wis.

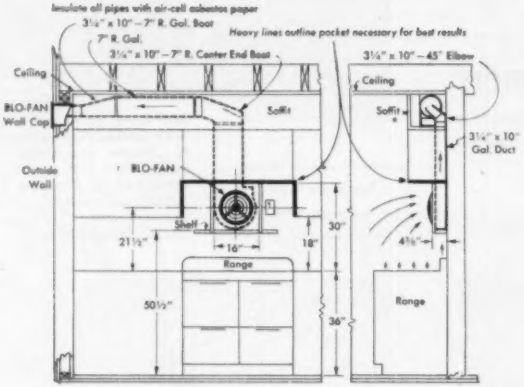
Pioneers in the development and manufacturing of Air-Cooled transformers

Blo-Fan* ELECTRIC VENTILATOR

Designed for old or new

You don't have to cut walls or ceiling to install Blo-Fan

Here's how to do it!



Mount Blo-Fan on the wall above the kitchen range, where it whisks out steamy grease, fumes and odors, as they rise, before they can spread. Run your ducting through the cabinets and out the soffit where the unwanted air is discharged through a Blo-Fan wall cap.

Blo-Fan *—The most versatile fan on the market*

In one- or two-story construction, old or new, Blo-Fan can be installed in the ceiling where it will discharge vertically or horizontally . . . Or, installed in an inside wall, it discharges up or down . . . No matter what your kitchen ventilating problem may be, Blo-Fan provides a simple and easy answer!!!

Blo-Fan consists of three parts: housing, motor and blade unit, and the grille.

No tools required to fasten motor unit and grille into housing.

9-Speed Switch

Another Blo-Fan Exclusive

Spot ventilation at the point of air pollution

*Trade Mark Reg.

Remember *– Blo-Fan is ideal for bath, game room and laundry, too!*

A postcard will bring you complete Blo-Fan information and the names of your nearby distributors.

Stocked by more than 600 wholesalers in 350 cities.

construction

Pry-Lites RECESSED LIGHTING FIXTURES

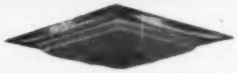
It's simple to replace old-fashioned fixtures with modern Pry-Lites

Pry-Lites Feature Six Interchangeable Fronts for the "1000 series" in chrome, brass, copper or painted silver grey finishes.

—1 lens, 100 or 150 watt

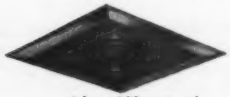
—2 lens, 100 or 150 watt

—3 lens, 150 watt only

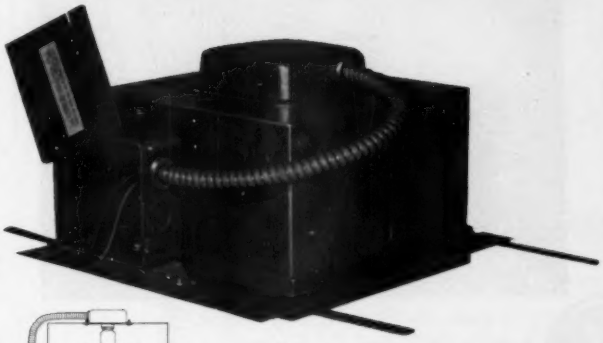


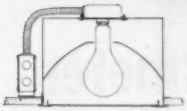
—4 lens, 100 or 150 watt

—5 lens, 100 watt only



—6 lens, 100 watt only





Housing size, Model #1000: 9" x 9" x 8"

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The "1000 series" of modern recessed Pry-Lite fixtures are exceptionally economical to install . . . They fit between standard joists or studs and are equipped with plaster flanges that *fit any finish* . . . Adjustable mounting straps *eliminate* framing-in expense . . . A 4" pull box is accessible on either side and is attached to the housing . . . The housing can be inserted or removed through the plaster flange . . . And, these Pry-Lites may be wired with Romex, R, T, or TW wire—NO asbestos wire or separate pull box required . . . All of which adds up to an ideal fixture for one- or two-story construction, whether it be old or new.

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Type AK-2

Now you can measure a-c power on non-metered loads without cutting conductors or interrupting service! Just clip the long voltage leads to terminals or binding posts, snap the hook around the conductor, and you're ready to read.

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LIST PRICE $84.75
Type AK-2 Ratings
3-6-20-60-200-300 kw
15-600 amperes
100-600 volts

GENERAL ELECTRIC

602-174

(56) Hobart Brothers Company, Troy, Ohio, has announced a new line of transformer type ac arc welders which has no moving parts. . . . (57) Two new silicone resins for electrical applications have been announced by General Electric Company, Pittsfield, Mass. . . . (58) Indoor and outdoor acoustics, machinery noise, and hearing requirements are measured with a new pocket-size sound level meter developed by Herman Hosmer Scott, Inc., Cambridge, Mass.

(59) A new, semi-portable series of "Hypot" high potential insulation breakdown testing instruments, with test voltage ranges up to 30,000 VAC and capacities to 1.65 kva is being manufactured by Associated Research, Inc., Chicago, Ill. . . . (60) A new line of automatic type splices and deadends for 5/16 inch and 3/8 inch steel strand messenger, static, and guy wires has been introduced by Reliable Electric Company, Chicago, Ill. . . . (61) Leach Relay Co., Los Angeles, Calif. has added to its line, a new mechanical latching type, No. 9601, relay.

(62) A new industrial vacuum cleaner designed for both wet and dry pick-up has been announced by the General Electric Company, Bridgeport, Conn.

CATALOGS and BULLETINS

(63) ELECTRONIC TIME SWITCH for interval timing, time delay and programming is subject of 6-page presentation including wiring diagrams and specifications. Henry G. Dietz Co.

(64) CONTROL CABLE, small diameter 600-volt, is specified and analyzed in 2-color folder. Rockbestos Products Corp.

(65) TONG-METER, pocket sized ac volt-ammeter, is discussed in 2-color file folder. Pyramid Instrument Co.

(66) INDUSTRIAL PUMPS, centrifugal and positive displacement, are specified and pictured in bulletins 100 and 200. Eastern Industries.

(67) RIVETS. tubular and split in wide variety of metals, are sketched, specified and priced in 12-page 3-color presentation including data on foot- and power-driven setters. Chicago Rivet and Machine Co.

(68) RLM SPECIFICATIONS, 44 pages with 18 different fluorescent and incandescent lighting units, is available

in booklet form. RLM Standards Institute.

(69) COST REDUCTION in production construction and maintenance is subject of multi-fold chart containing 45 products useful in the electrical field. Ideal Industries, Inc.

(70) RECESSED TROFFERS, deep and shallow, holding from 1 to 4 fluorescent lamps, lensed or louvered, are presented in file 2 section 10-A with mounting details, dimensions and specifications. Edwin F. Guth Co.

(71) COMFORT COOLING with variety of window, attic and roof fans for residential use is subject of 12-page bulletin. Emerson Electric Mfg. Co.

(72) LAMPHOLDERS and accessories for indoor and outdoor use of reflector lamps are sketched in bulletin 121-50. Steber Mfg. Co.

(73) MERCURY CLUTCHES for gasoline and power-driven motor installations are discussed in bulletins 216, 217 and 218. Automatic Steel Products, Inc.

(74) VIBRATION isolators and mounting bases are described in catalog 502 with drawings, tables, weights and principles of design. The Barry Corp.

(75) BLIND RIVETS with threads are presented with data on wrenches and installation tools in 20-page 2-color booklet titled Rivnuts. B. F. Goodrich.

(76) SYNCHRO UNITS for electrical instrumentation are subject of 12-page 2-color folder. Arma Corp.

(77) TOOL CATALOG with grinder selector chart and question-answer section is a 28-page presentation. The Dumore Co.

(78) SCHOOLROOM VENTILATION is reference file for contractors, engineers and architects. Herman Nelson Div., American Air Filter Co., Inc.

(79) UNDERFLOOR distribution systems are detailed and discussed in 36-page AIA file 31C62. National Electric Products Corp.

(80) INSULATION TESTERS for fast, accurate high-voltage use are presented in bulletin 4A. Associated Research, Inc.

(81) HANGERS of disconnecting and lowering types as well as accessories for cleaning, relamping and maintaining high bay lighting fixtures are presented in 80-page catalog. Thompson Electric Co.

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(82) RACKS of bolted frame construction, eliminating necessity for drilling or welding and permitting dismantling and reassembly, are subject of 24-page catalog 600. Unistrut Products Co.

(83) VARIABLE SPEED TRANSMISSIONS with automatic speed locking device are discussed on single file sheet. Frazier & Son.

(84) HYDRAULIC BENDER attachment for pipe, bar and angle stock is described in 2-color file sheet. Hossfeld Mfg. Co.

(85) LIGHTING for public buildings, from front lobby to rear exit, is pictured and specified in 4-page presentation. Moe-Bridges Corp.

(86) V-BELTS for both light and heavy duty are sketched, specified and priced in catalog bulletins FHP 101 and MV 201. Maurey Mfg. Corp.

(87) POTHEADS of soldered porcelain construction are pictured, sketched, specified and described in 18-page bulletin AA50, G & W Elec. Specialty Co.

(88) INSULATION TESTERS for heavy duty work with extra long scales and wide ranges are discussed in 2-color 24-page bulletin 21-20. James G. Biddle Co.

(89) PLEXOLINE lighting systems, using combinations of circular incandescent units, linear fluorescent sections and adapter fittings for obtaining variety of angular and abstract patterns are diagrammed and discussed in multi-color 12-page presentation. Day-Brite Lighting, Inc.

(90) MAGNETIC CONTROLS such as starters, contactors, relays and accessories are included in 16-page catalog 50. Furnas Electric Co.

(91) REPRODUCTION equipment such as high fidelity speakers, filters, adapters and networks is subject of illustrated 6-page presentation. University Loudspeakers, Inc.

(92) CONNECTOR wiring guide, including 56 pages of tables, charts, wiring data and installation photographs, is pocket-sized catalog prepared for contractors and maintenance men. Burndy Engineering Co.

(93) ROD THREADING machine, U-bolt bender, draw and hydraulic punches are discussed in series of 3-color file sheets. Nischan Products Co.

(94) TRANSFORMER manual discussing care and maintenance of dry-type units includes NEMA standards. Kuhlman Electric Co.

(95) SWITCHBOARDS and panels with rota-swing switches are pictured and discussed in 2-color file folder. Pelham Electric Mfg. Corp.

(96) VENTILATION for residential kitchens through wall, ceiling and window fan units is covered in detail in 8-page folio X656. Emerson-Electric Mfg. Co.

(97) LAMP HOLDERS with new locking mechanism and fast assembly provisions, used with fluorescent fixtures, are sketched and described in single page file sheet. Lloyd Electrical Products.

(98) POWER TOOLS and accessories for buffing, cleaning, drilling, grinding, sanding, sawing and brushing are presented in pocket-sized 16-page booklet. Portable Electric Tools, Inc.

(99) MAGNET WIRE, Formex and Deltabestos, is discussed from development to applications in 36-page booklet 19-329. General Electric Co.

(100) CLASSROOM coordination of all contributory elements is subject of 48-page booklet titled "The co-ordinated Classroom" by D. B. Harmon. F. W. Wakefield Brass Co.

(101) MACHINE TOOL CONDUIT is discussed, diagrammed and specified in 1-page file sheet. Chicago Metal Hose Corp.

(102) REMOVABLE LOUVERS for fluorescent fixtures are dimensioned and illustrated in bulletin 455. Lighting Products, Inc.

(103) OIL WELL ELECTRIFICATION guide, B4039, discusses production methods, motors and control equipment, transformers, distribution systems, lightning protection, power factor correction and related subject matter in 48-page booklet. Westinghouse Electric Corp.

(104) TRANSFORMERS, both power and distribution models, as well as 3 types of load-ratio-control mechanisms are presented in bulletin 1B6186B. Allis-Chalmers Mfg. Co.

(105) CONVEYING SYSTEMS are graphically sketched and described in 12-page bulletin 103. Convair Corp.

(106) AUTOMATIC LIGHTS that cut in when power fails are priced and described in 4-page presentation. Electric Cord Co.

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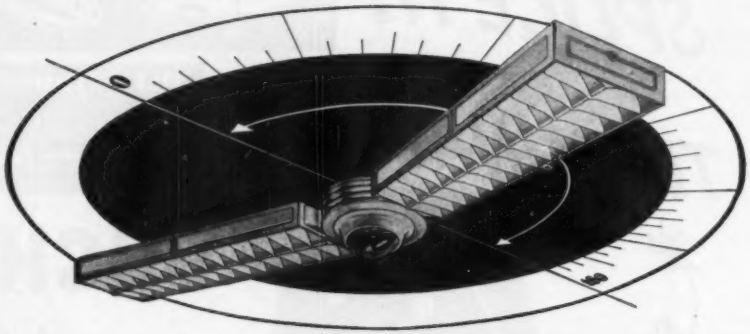

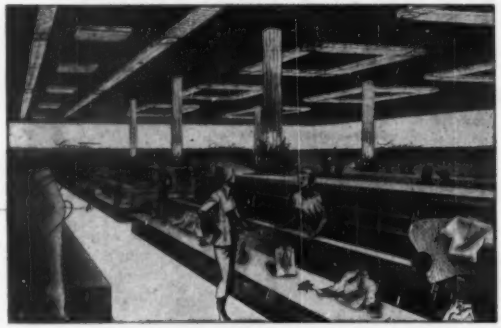

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Reader's Quiz

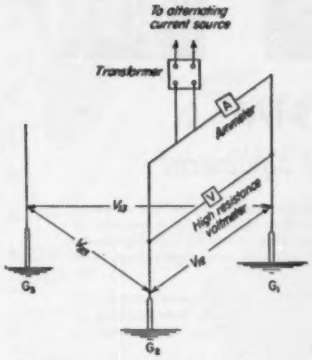
Measuring Ground Resistance

QUESTION 353—Our current problem is the measuring of the true resistance to earth of our ground rods without the purchase of a groundometer. We have a number of ammeters and voltmeters, both ac and dc, in many ranges. I know it is possible to use these to find true ground resistance, but how, and what is the formula?—L.R.D.

A. TO QUESTION 353—Make two reference grounds about 100 feet away from the a-c voltage supply, and the two reference grounds. Measure the voltage between the ground terminals with a high resistance voltmeter. If the voltage supply is 11 volts — across the reference grounds it is 1 volt, and across the resistor it is 10 volts—then we have a ground resistance of .2 ohms between the ground terminals, because voltage divides between resistances according to the ratio between the resistances; the higher resistance getting the higher voltage. Now, remove a reference ground and connect a ground rod in its place to get the ground rod resistance. Repeat with the other grounds. I use two reference grounds to help me remove the chance that an underground set of pipes in dry ground will give me a wrong reading.—H.S.

A. TO QUESTION 353—The accurate measurement of ground resistance of ground rods with respect to absolute earth is very difficult. However, due to the fact that practically all the resistance of a ground connection is concentrated in the area immediately surrounding the ground rod, a simple method employing an ammeter, a high resistance voltmeter and a small transformer can be used to give fairly accurate results.

In this method, called the triangulation method, two auxiliary test grounds are used. Since for ¾ inch by 3-ft. ground rod approximately 90% of the resistance is within a 6 foot radius, the test grounds should be placed at least 20 feet from the ground rod and the same distance from each other. The soil about the



auxiliary test grounds should be as nearly the same moisture content and consistency as the rod ground and their ground resistances are greater than ten times the rod ground resistance, the test may be meaningless.

The series resistance of each pair of grounds is measured as indicated in the diagram, using alternating current. The voltage of the test transformer will depend on the ground resistance and on the ranges of the meters available. It is best to keep the current as low as possible to avoid any heating at the ground connections. For example, say the resistance of the ground connection is approximately 120 ohms and the transformer has a 12 volt secondary. The current would then be 0.1 ampere. With this setup, a 30-volt scale voltmeter and a one-ampere ammeter could be used. Some experimenting will be required to determine the best combination.

To calculate the resistance of the ground rod, use formula below:

$$R_1 = \frac{\frac{V_{12}}{I_{12}} + \frac{V_{13}}{I_{13}} - \frac{V_{23}}{I_{23}}}{2}$$

wherein

- R_1 = ground resistance of rod
- V_{12} = voltage drop across the ground rod and one auxiliary test ground in series
- V_{13} = voltage drop across the ground rod and the other auxiliary test ground in series
- V_{23} = voltage drop across the two auxiliary test grounds in series
- I_{12} = current in amperes flowing when V_{12} is measured
- I_{13} = current in amperes flowing when V_{13} is measured
- I_{23} = current in amperes flowing when V_{23} is measured

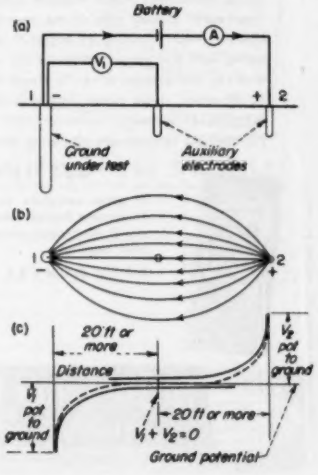
Several positions of the auxiliary test grounds at various distances should be tried to check the results obtained. The resistances of the auxiliary test grounds may be checked by substituting the same voltage and current measurements in the following formulae:

$$R_2 = \frac{\frac{V_{12}}{I_{12}} + \frac{V_{23}}{I_{23}} - \frac{V_{13}}{I_{13}}}{2}$$

$$R_3 = \frac{\frac{V_{13}}{I_{13}} + \frac{V_{23}}{I_{23}} - \frac{V_{12}}{I_{12}}}{2}$$

—D.H.F.

A. TO QUESTION 353—Inasmuch as grounding of electrical equipment is a measure of protection against injury to life and property, it is good practice to check the effectiveness of the system periodically. The check made is for observing the effects of corrosion, if any, and possible drying out of the soil by testing for continuity and measuring the ground resistance. According to the National Electrical Code, ground resistance should not exceed 3 ohms for an underground water- or gas-piping system and 25 ohms for metal frames of buildings, metal well casings, and driven ground rods. If these minimum values can not be met, ground resistance can be lowered by using a larger diameter galvanized ground rod or pipe



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than the required minimum of ¾ inch size; by using several galvanized rods spaced not less than 6 ft. apart and connecting them in parallel; by using rods penetrating the earth deeper than the required 8 ft. minimum; or by treating the immediate vicinity of the rods with about 50 lbs. of a chemical like magnesium sulphate, every two or three years, reducing the quantity and increasing the interval with time.

Ac rather than dc is used for ground resistance measurements in order to minimize electrolytic action and avoid effects of polarization. If dc is to be used, at least 110 volts should be applied in order to reduce the effects of polarization. The use of 110 volt ac, obtained from the secondary of an isolating transformer is usually satisfactory. When the value of ground resistance to be measured is very low, lower values of ac voltage may be used, avoiding the difficulty of handling high ground currents.

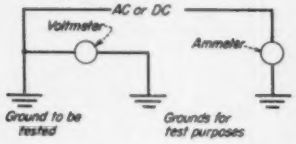
The design of ground connections and the measurement of their resistance are problems which involve varying resistivity and non-uniformity of the conducting section. These depend on the climate, the nature of the soil, and the type of ground connection used.

The simplest method of measuring the ground resistance of a driven rod is when a water hydrant or bonded rail system is within easy reach. A current is passed through the driven rod and the auxiliary large ground system connected in series. The total voltage divided by the current gives the ground resistance. The resistance to ground of the large system being negligible, the calculated resistance is that of the driven rod to ground.

In measuring the resistance of a driven rod, two additional temporary electrodes or rods are driven to a depth of about 3 ft. One electrode should be at least 40 ft. away from the rod being tested and the other about midway between the other two, with an ammeter and a voltmeter connected as shown in Fig. 1a. For simplicity, a battery is used instead of the ac source, The ground resistance of the rod is determined by dividing the voltmeter reading by the ammeter reading. The lines of current flow between the two outer rods are assumed to follow their respective radii as indicated in Fig. 1b. The potential at midpoint is equal to the sum of the potentials of the two rods with respect to ground and therefore equal to zero. Due to the very small IR drop observed as a result of the comparatively low resistance offered at the midway point, the latter may be considered located at infinity. The major part of the IR drop occurs in the immediate vicinity of the two rods. The variation of IR drop with distance is shown in Fig. 1c.—R.G.C.

A. TO QUESTION 353—It is best to use ac for ground resistance measurements. Dc is satisfactory but an extra test is necessary to eliminate the effect of any stray currents in the ground. The second test, if dc is used, is made with reversed polarity and the resistance value obtained is averaged with the first test. Whether ac or dc is used, the voltage source should have no grounds other than those shown in the diagram.

The distance between grounds should be about 25 feet or more and none should be interconnected except through the earth. The grounds made for the test should be rods longer than two feet. The purpose of using two of the extra grounds is to minimize



the effect of their resistance by separating the voltage to current circuits. If desired, these two extra grounds could be replaced by one ground to a buried water pipe system or other ground of known low resistance. This latter method should give a slightly higher value for the resistance of the ground under test.

The resistance is figured using Ohm's Law. Resistance equals volts divided by amperes. Since L.R.D. has a number of meters available, he can select those applicable to a voltage which is readily available for test. —C.S.

Electronic Equipment

QUESTION—Some time ago I was checking some electronic equipment which was not operating properly. The equipment included a thyratron. Several times the thyratron flashed and glowed all over. Normally, the tube, when conducting, had only a small glow near the elements. Can anyone explain this condition?—C. S.

ANSWER to C. S.—There are two reasons for thyratrons flashing over. The first is due to flaws in the equipment causing short circuits and therefore overloads in the current provided by the thyratron. The second is due to the emission of gas from the elements of the tube. The occasional flashback is not serious, but if this condition persists, then a check must be made on the current supplied by the

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tube. If this is normal, then the tube is at fault and must be replaced.

—H. H. S.

ANSWER to C. S.—Thyratron tubes are used in many different ways in electronic equipment and without knowing the exact application and circuit arangement of this question, it would be impossible to explain the exact cause of the erratic operation of the tube. It was stated that the equipment was not operating properly and the "flashing" of the thyratron was no doubt an effect rather than the cause of the trouble.

Since the grid of the thyratron triggers the tube and cannot control conduction, full conduction of this gas filled tube takes place immediately upon ionization, and is limited only by the resistance of the load circuit.

In this case it is probable that an intermittent short circuit between the anode and cathode circuits of the tube is decreasing the load resistance to a point where dangerously high currents are being passed by the thyratron which will soon destroy the tube.

In cases where phase shift grid control is employed, a difference in brilliance of the normal glow of the tube can be observed between the periods of full conduction and partial conduction, but the brilliant flashing would not be observed.—C. E. F.

ANSWER to C. S.—This question is rather difficult to answer without knowing the nature of the circuits connected to the thyratron. Excessive flashing and glowing usually indicates the possibility of an abnormally high load current resulting from improper load conditions imposed on the tube.

This high load current causes excessive ionization of the gas within the tube which produces an abnormal glow or flash.—E. C. E.

Can you ANSWER these QUESTIONS

QUESTION Y16—Is there any practical method in use to determine the correct size of secondary resistance and wattage of the same to be applied with a Drum switch to the secondary of a wound rotor three phase motor?

For example, assume that you had a 100 hp., 220 volt, 3 phase, 60 cycle motor, that the original nameplate had been replaced by some motor repair company with their own, and the only information they supplied was that mentioned above. There is no marking on the shaft ends, keyway, etc. The only thing the manufacturer could assure you of is that this motor has a 100 hp., 220 volt, 3 phase, 60 cycle frame.

There is some method whereby you excite the stator with 220 volt, 3 phase and check the open circuit voltage on any two of the rotor rings.

Do any of your readers know this or other methods?—W.H.C.

QUESTION Z16—We have a 5 hp. 3 phase Peerless motor on air compressor duty that will blow fuses occasionally. It has no type number, 220-440 volts operating on 220. At times, it will go for several weeks without blowing fuses and sometimes it will blow several in a week, not always the same fuse blows. The overload heaters are the ones sent with this motor and switch and never kick out until one fuse blows. The motor circuit is fused with 30 amp. fusetats. Could it be possible the voltage is sometimes too high and causes too much starting current? It has never gone over 223 volts while I had a volt meter on it.—A.E.

QUESTION A17—On our 110/220 volt secondary system, the neutral is grounded at the transformer and also in the residences to the water pipe.

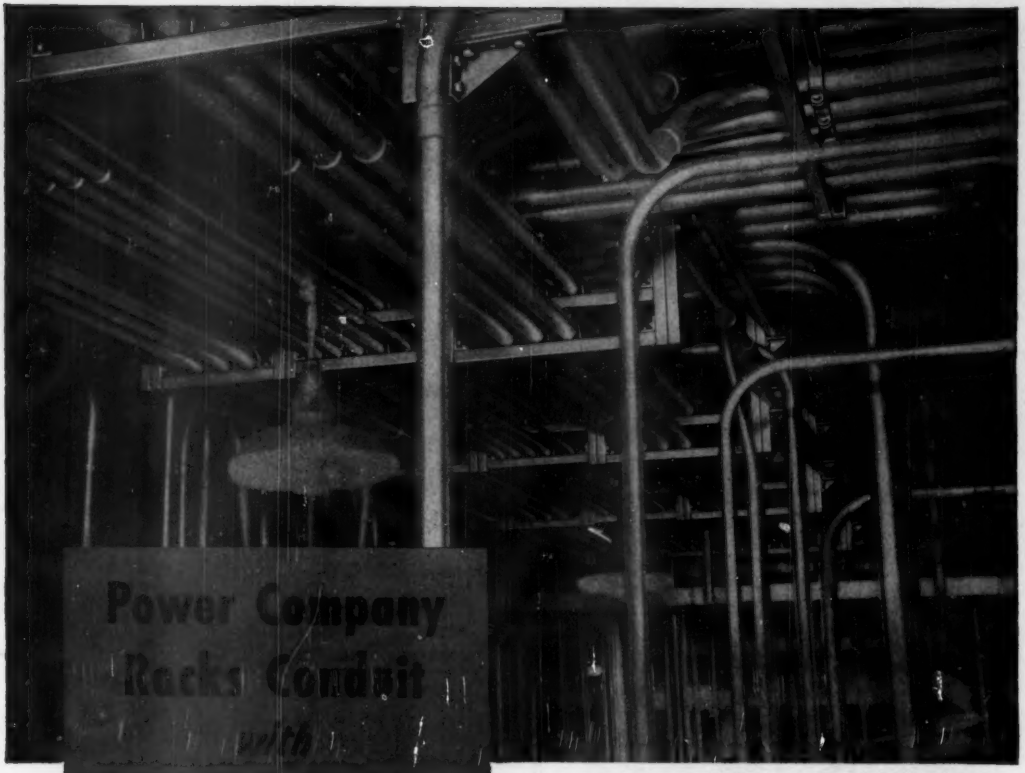
We find, with a Weston clamp-on ammeter, current flowing (from 2 to 20 amp.) in the ground wire in the residences but not in the ground wire at the transformer.

By disconnecting the wire from a water pipe, we get a spark but a neon tester will not light when placed in series with ground wire and water pipe.

What causes this current to flow and what effect does it have on the circuit?—A.C.J.

QUESTION B17—We have been installing solenoids and control circuits at 110 volts, 60 cycle, from our 440 volt power circuits. This requires a transformer 440 volt to 110 volt. What size transformer should be used? For example, a solenoid with an inrush current of 10 amperes and a holding current of 1 ampere. I have been advised to use a transformer of 100% inrush current to 25% inrush current. The difference in size makes quite a difference in cost, in which I am very interested, and would like to know what size transformer to use.—W.L.C.

PLEASE SEND IN YOUR ANSWER BY AUG. 15



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Earth Temp. ambient—20 C

	Transite	Other
Total Therm. Res. to Dielectric Loss (C watts/ft.)	5.66	6.17
Total Therm. Res. to Copper Loss (C watts/ft.)	4.44	4.95
Temp. Rise from Dielectric Loss (C)	1.9	2.1
Allowable Rise for Copper Loss (C)	59.1	58.9
Allowable Watts per ft. cable	4.44	3.96
Allowable Current—(Amps. per cdr.)	386.	365.
Allowable Current—(Relative %)	105.6	100.

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Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector, New York Board of Fire Underwriters, New York, N. Y.
Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

Questions on the Code

Conductors

Q. *Why are we required to run a No. 6 neutral conductor in an overhead service when the load requires only No. 6 ungrounded conductors? When they permit us to run a No. 6 neutral with No. 4 ungrounded conductors it would seem only logical to permit the use of a No. 8 neutral when No. 6 conductors are adequate to supply the load.*—H. E. P.

A. You will find a fine print note at the bottom of Section 2304 of the Code which reads as follows: "It is recommended that a minimum of three No. 6 conductors be used for all service installations." Now the reason it is suggested that a No. 6 neutral be the minimum size conductor to a building is not because of the possible electrical load that conductor will be subjected to, but instead is because of the possible ice and weather loading. In other words, it is entirely a reliability provision and not a current carrying problem which is involved and while this is not a requirement of the National Electrical Code but simply a recommendation, it has been made a requirement by many inspection authorities in various parts of the country.—G. R.

Service Switches

Q. *Are horsepower rated service switches required in a farm garage or machine shop where an R. E. A. type welder is likely to be used?*—S. A. D.

A. No. The National Electrical Code would not require the use of a horsepower rated service switch. Under Section 6313 of this code you will note the controller for the transformer arc welder must be of the horsepower rated type and inasmuch as most of the better transformer type arc welders are equipped with a control switch by their manufacturer, it is, of course, not necessary to provide a second control switch. For a welder not so equipped, this section of the code will require that you use a horsepower rated switch, the rating of which is determined by multiplying the voltage by the factor shown and for 220 volt welders this factor is .1, and inasmuch as the great majority of R. E. A. type transformers are of the 37 ampere primary rated type, the switch used as a controller should be rated as 5 horsepower. The circuit supplying this welder may be protected by over-current protective devices having a rating not in excess of 200% of the input rating of the welder. Here again inasmuch as the average input rating will be 37 amperes, the circuit overcurrent protection would have to consist of 60 ampere fuses or a 50 ampere breaker.—G. R.

Lighting Fixtures

Q. *In wiring the gasoline tank truck filling platform, is it necessary to utilize explosion-proof lighting fixtures if those fixtures are located more than 15 feet above the ground?*—F. F. O.

A. All electrical equipment attached to or located on a filling platform must comply with the provisions of Class 1 Division 2 of Article 500 of the National Electrical Code and under that article you will note in Section 5019b. 2. the following sentence: "Lighting fixtures for fixed lighting shall be protected from mechanical injury by suitable guards or by location." No mention is made of height above ground or of height above the gasoline trucks which will be filled with the result very few enforcement agencies follow this portion of the National Electrical Code as they feel the hazard involved is too severe to permit the use of other than a Class 1 Group D lighting fixture for a tank truck filling platform unless its location is such it is most unlikely for the fumes to reach it during filling operations. While it is true that on the average day there will be sufficient air movement to create currents and drafts about a loading platform that will properly diffuse gasoline vapors being liberated, it is also true there is the occasional day, during the summer especially, when there is no movement of air to dissipate these vapors and it is entirely possible for the temperature of part of a lighting fixture of the ordinary type to be above the ignition temperature of gasoline vapors. Hence, it does not seem advisable to use other than the explosion-proof Glass 1 Group D type of fixture even though the Code does not require such fixtures at this time. You, therefore, should contact your local inspector before making this installation.—G. R.

Feeders

Q. *A large metalworking plant in this city has asked us to run feeders from their present service vault for a distance of about 470 feet to supply a bank of electrically heated ovens which they propose to install. Service comes into this plant at 13,800 volts and we would like to run these feeders at this voltage to a transformer bank located adjacent to the new oven installation. Will the Code permit us to run these feeder conductors as open wiring with triangular spacing to reduce the copper size or must they be enclosed within conduit?*—M. H.

A. The National Electrical Code under Section 2387 gives permission to run open service conductors where they can be so located they will not be accessible to other than qualified persons provided the voltage is not in excess of 15,000 volts. And then under Section 7111 you will note conductors other than service conductors having a voltage in excess of 600 volts must be run in rigid conduit, duct, armored cable or in special multiple conductor cable approved for the purpose. Therefore, in your instance if this set of so-called feeders can be termed an extension of the service and if they can be so installed they will not be accessible to other than qualified persons, such an installation might be made provided it does not violate some existing local ordinance. It would be advisable for you to contact the electrical inspector having jurisdiction and consult with him

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before making definite plans for this installation. If approval can be obtained for the use of the open type of installation, we wish to call your attention to Section 2387 a., which will require that the conductors be rigidly supported on glass, porcelain or other insulators approved for the purpose which will maintain a separation not less than 8 inches between conductors except at the apparatus or devices to which they are attached. It is also necessary these supports provide at least 3 inches clearance between the conductors and the surface over which they are run.—G. R.

Farm Wiring

Q. *Will the Code permit the use of a windmill tower as a support for overhead wires on a farm property and can we use ordinary service entrance cable run down one of the windmill tower legs to supply the motor driving the pump on the well?*—J. N. A.

A. The National Electrical Code does not cover either of your questions, however, experience has indicated it is not wise to utilize a windmill tower as a support for overhead conductors on an electrified farm due to the fact proper maintenance of the tower usually ceases when the farmer starts utilizing electric power for his water supply. A survey of farms which have been wired for some time will indicate the average windmill tower no longer forms a reliable support for overhead conductors. If such a tower is properly maintained, the Code, of course, would not prohibit the use of a service entrance type cable run down one of the legs provided it was supported every 4½ feet if in contact with the leg of the tower or at least at intervals not exceeding 15 feet if 2 inches or more separation are maintained between the cable and the tower leg.—G. R.

Fixtures on Boxes

Q. *In this locality it has been, in the past years, an accepted practice that small lighting fixtures, such as lumiline brackets, fluorescent brackets and other small porch brackets, could be installed or mounted on switch or receptacle boxes, either in new or old work, if the boxes were securely supported.*

Most of these fixtures have a narrow back plate and will not cover an ordinary round outlet box without the use of special additional covers mounted under the fixture. These fixtures mentioned above, all bear the Underwriters' approval label and are evidently designed for use on switch boxes as the back plates and straps are drilled exactly to install on flush mounted device boxes. Our inspection Department now says that in their opinion Paragraph 3713, Art. 370 applies to this question and that flush mounted device boxes cannot be used for fixture outlets.

Question: Is it the intent and purpose in Section 3713 of the Code, to prohibit the use of flush mounting boxes for any other purpose than mounting such devices or does Paragraph 3719, permit the use of such boxes to install such fixtures?

—F. B. L.

A. Section 3713 does not apply in this case nor does the Code attempt to say that a switch or receptacle box shall not be used for any other purpose if its design fits that purpose. Section 3713 merely states that where such flush devices are to be enclosed, the enclosing box shall be of a proper design.

Section 3719 might apply unless the fixture is designed to fit the box as it evidently does in this case. The use of the fixtures described above should be all right provided there is no combustible material exposed at the outlet and Section 4124 is complied with.

F. N. M. S.

Branch Circuits

Q. *Is it O.K. to use 20 amp. branch circuits in schools if I use No. 12 wire. Mogul base lampholders and No. 14 fixture wire?*—F. N. H.

A. Yes. The various provisions of the rules for branch circuits are complied with. See the summary in Section 2127 of the Code.—F. N. M. S.

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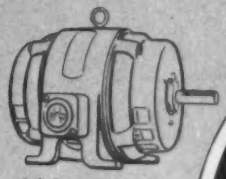
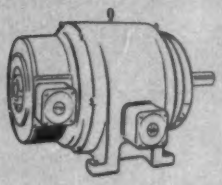
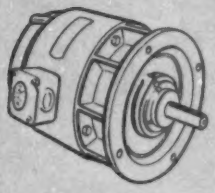


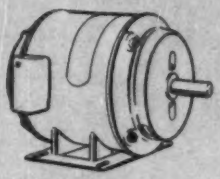
Special duty motors



Wound rotor motors



Flange mounted motors



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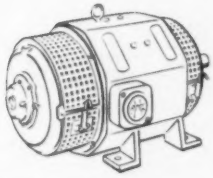

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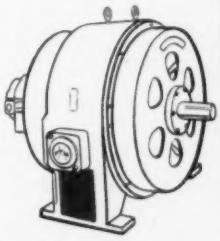

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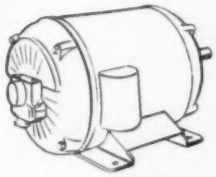

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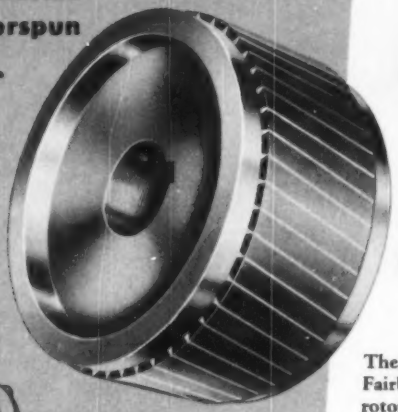

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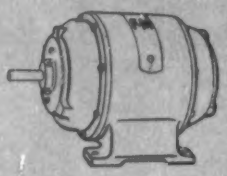

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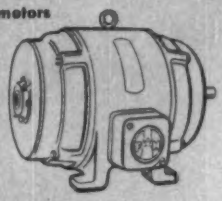

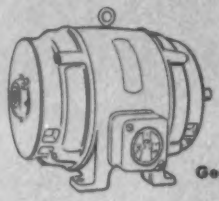

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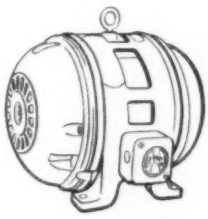

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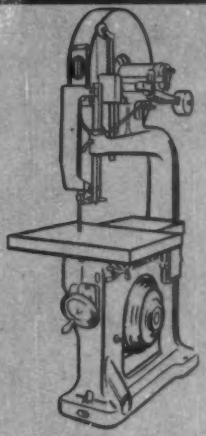

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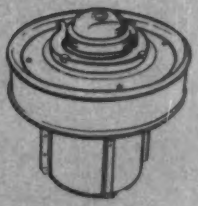

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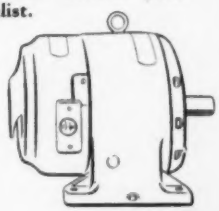
There are many other things you should know about Axial Air-Gap motors if you are designing motor-driven equipment—or in any other way involved with motor selection. Consult your Fairbanks-Morse sales specialist.



MOTORGEAR. The Axial Air-Gap motor combined with a helical gear reducer makes industry's smallest, lightest, most compact, slow speed unit. (Up to 10 hp.)

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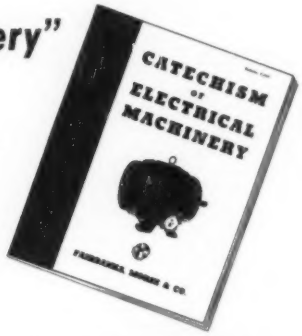
the Name is... **FAIRBANKS-MORSE**

If you Buy, Specify or use Motors, You Need this Information!

"Pocket Panorama" of the complete line of Fairbanks-Morse Motors—Generators

Here is a handy reference which shows the complete line of Fairbanks-Morse motor and generating equipment along with basic information on each unit. Over 40 sizes and types illustrated—good usable data for anyone concerned with motor selection and application.

Famous "Catechism of Electrical Machinery" an invaluable reference



Here is a fund of basic information on the design, performance and proper use of the common types of direct current and alternating current motors, generators and control equipment. Primarily intended for those who are not widely familiar with electrical phenomena or terminology, it also has been widely accepted by engineers, maintenance men, designers and others as an aid in instruction of new men for factory, engineering or sales departments. Used by the thousands in some of the country's leading technical institutions it has no equal in simplifying and explaining the intricacies of electrical machinery.

Your Request written on your letterhead, addressed to your nearest Fairbanks-Morse Branch Office (listed on these pages) will be promptly answered.

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DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • PUMPS • SCALES
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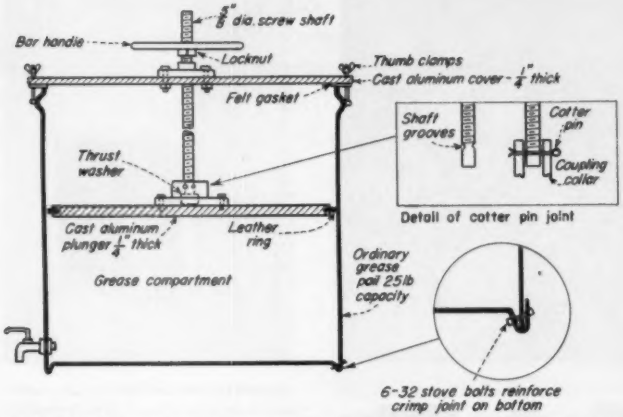
Motor Shops



SECTIONAL VIEW of ball bearing grease dispenser, exaggerated in some details to illustrate features of the unit. Container is a conventional grease pail.

Bearing Grease Dispenser

The natural tendency in most electric motor repair shops, when packing motor ball bearings, is to remove the top from a pail of grease and dip out the lubricant with the fingers, spatula or a piece of wood. This may work well, but there is always the possibility of contaminating the remaining grease with dirt, grit or even small bits of metal. Removal of such foreign matter not only takes time but also wastes lubricant.

All these possibilities are eliminated in the motor service shop of the French-Gerleman Electric Company in St. Louis. Mechanics simply transformed a conventional grease pail (25 pound capacity) into a convenient, economical dispenser by using the principle of the common grease gun.

The top of the pail was replaced with a ¼-inch thick cast aluminum cover having slots to accommodate thumb-screw clamps. A felt gasket is between the cover and pail rim. In the center of the cover is a hole with a threaded collar through which a screw shaft can be turned. A locknut holds a bar handle securely on the shaft.

Mounted to the bottom of the shaft, through a half-coupling assembly, is a "piston" made of ¼-inch thick cast aluminum. A groove in the rim of the piston holds a leather ring which hugs the walls of the pail. The rotating shaft moves the piston up or down (depending upon direction of rotation) by means of a cotter-pin joint in the coupling collar. A groove, machined in the shaft, seats two cotter pins (one on each side) inserted in holes drilled in the coupling collar. A thrust washer between the shaft and piston is part of the assembly. Thus, the screw shaft can turn freely and still move the piston.

The type of pail used has a bottom that is fastened to the cylinder walls by an overlapping crimp joint. Although strong enough to hold the weight of the grease in the pail, there was a possibility that this joint would fail when the lubricant was compressed by the piston. This problem was solved by drilling six equally spaced holes through the crimp joint and reinforcing it with 6-32 stove bolts.

As the shaft handle is turned clockwise, the piston moves downward and forces the grease out of a faucet near the bottom of the pail. After enough lubricant has been dispensed, the screw shaft is backed up a few turns to remove the pressure and prevent oozing at the faucet.

Reloading the pail is a simple operation. The piston is backed up to the proper position for the amount of grease to be added and the cover removed by loosening the thumb clamps. After the lubricant is added, the cover is replaced and the unit is again ready for use.

Normally, the unit is placed on a low stool or platform at a convenient height to assure easy operation.

Outdoor Oven Has Indoor Access

By building an outdoor burn-out oven with indoor access, the Phoenix Electric Company, Mansfield, Ohio, motor repair establishment, has effected a considerable reduction in insurance premiums. Access to the gas-fired unit is through a counterweighted steel door which slides up and down in steel guides on the interior wall of the shop.

The oven proper consists of a sheet steel enclosure (3-ft. wide, 4-ft. high, 4-ft. deep) that extends out beyond the building wall. A layer of fire brick covers the steel oven. Around the fire brick is a finish course of common brick. A high steel stack provides a natural draft for the low tem-

BURN-OUT OVEN extends beyond building wall; is covered with fire brick and finish course of common brick; has high stack for natural draft.

ANGLE-IRON TRUCK can be rolled directly over burners on oven floor.

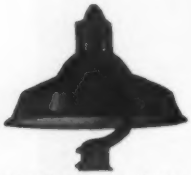
The boss on the job says—

"That's what I call Good Design and Construction"

QUAD LIGHTING

ANGLE REFLECTORS FOR SIGNS

FLOODLIGHTS FOR AREA LIGHTING



POST TOP OR PUMP ISLAND REFLECTORS

It's easy to see why men who do the wiring are strong for QUAD. Among the things that please the boss is the ease of wiring and the hearty O. K. he gets from customers for all around good installations.

You'll find the correct unit for most outdoor lighting requirements in this modern and complete line. You'll also find that these units are flexible in design, fully weatherproof, and that the porcelain finish is permanent.

Make QUADRANGLE your headquarters for your outdoor lighting units and build a more profitable business.

Always refer to the QUAD catalog—it's most helpful. If you haven't a copy write for one.

QUADRANGLE MFG. CO.

325 S. PEORIA ST. CHICAGO 7, ILL.

COUNTER-WEIGHTED sliding steel door provides access to oven from shop interior. Manually operated electric timer with pilot light and warning bell control burner operation.

perature flame produced by the gas burners.

Heat is provided by a series of burners mounted on the center of the oven floor. Stators are placed on an angle-iron truck that can be pushed directly over the burners. A manually operated electric timer with pilot light shuts off the gas after the prescribed burn-out time has elapsed; rings a warning bell when the stator should be removed. Automatic control can be added if desired.

Use of the burn-out oven eliminates the danger of warping frames and laminations sometimes present when torch methods are employed; reduces the coil insulation to a fine ash; makes it an easy chore to remove the old copper.

Rolling Ladder For Storeroom Use

High ceilings have many advantages and a few drawbacks—one of the latter being the inaccessibility of parts and materials placed on shelves located above the normal reach of a storeroom clerk. This limitation has been erased in the storage area of the Reserve Electric Company of Cleveland, however, through the installation of a rolling ladder found in many of our shoe stores and merchandising marts. Since the ladder rolls freely along the overhead track, it can be quickly pushed to the required spot, providing easy access to all items located on the upper shelves.

BIDDLE *Instrument News*

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

NUMBER 2 OF A SERIES

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—From Transformer Manufacturers:

"We use this instrument almost continuously 24 hours a day, 5 days per week, and have come to depend on it as part of our production test facilities. Our experience has been that the instrument is accurate, dependable and generally very valuable in our work."

"You will be interested in hearing that your 'TTR' Tester has been doing an excellent job for us."

—From Large Power Companies:

"We like it very much,—don't know how we ever got along without it."

"The 'TTR' Set has proved valuable in making acceptance tests on new transformers and has materially reduced the time involved in testing."

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turns in a transformer in operation, which permitted it to be taken out of service before more serious trouble developed."

"We consider the 'TTR' Set one of the most valuable instruments for our transformer work. It saves time and calculations, and gives more accurate results than the other methods we'd been using. Our transformer men depend on the set—so much—there is seldom a day the set is not in use."

The names of these and other companies using the "TTR" Set are available on request. For information regarding this unique instrument, write for *Bulletin 55-ECM.*

GROUND CONNECTIONS ARE A PROTECTION

. . . only if they have low resistance

MEGGER® GROUND TESTING INSTRUMENTS PROVIDE EASY MEANS OF MEASUREMENT

Many seemingly good ground installations offer little protection since high earth resistance renders them ineffective.

There is no assurance that earth resistance will remain constant. It is therefore important that grounds be checked regularly by a reliable, accurate means.

Megger Ground Testing Instruments provide the means in one portable-easy-to-use instrument, for measuring resistance to earth of ground connections, such as rods, pipes, buried plates, and metallic structures. The method is quick, easy and economical—no calculations or adjustments are necessary—anyone can make tests—direct readings are taken in ohms from the scale and pointer.

Fileworthy literature on the subject of Ground Resistance Testing is available without obligation. Write for Bulletin 25J-ECM which gives instructions and diagrams, or Bulletin 25T2-ECM, "Grounding Electrical Circuits Effectively" by J. R. Eaton.

ONE INSTRUMENT FOR PRACTICALLY EVERY ELECTRICAL RESISTANCE MEASUREMENT

Bridge-Meg Measures a Fraction of an ohm up to 1000 megohms—Wheatstone Bridge Included —Varley Loop Optional

Wherever insulation resistance tests are made, wherever a Wheatstone bridge is needed, this instrument, with its hand-cranked, constant voltage generator is always ready for detecting, diagnosing, and locating electrical faults. Weighing only 15 pounds, this multi-purpose test set is an ideal field tool which quickly pays for itself over and over again.

The Wheatstone bridge is particularly useful in connection with measurements of all manner of coils, resistors and circuits.

The Varley Loop makes possible the location of faults on wires in telephone, telegraph, signal and electrical power systems in industrial plants and power companies.

Electrical modernization programs should include modern measurement and test methods. You should have complete information on this versatile Bridge-Meg Resistance Test Set.

Write for Bulletin 21-60-ECM.

Is Your LITERATURE FILE *Up to Date?*

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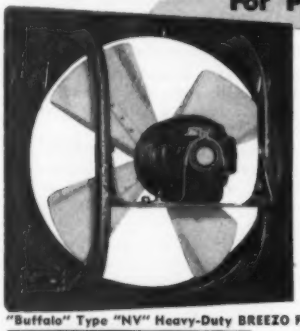

"Buffalo" Type "NV" Heavy-Duty BREEZO Fan

"Buffalo" Panel BREEZO Fan

THROUGHOUT industry, thousands of "Buffalo" Disk Fans are doing a quiet, steady, ECONOMICAL job of improving working conditions. Their square panel construction makes them easy to install wherever you need to draw off fumes, heat, smoke, steam, stale air. First cost for these husky, efficient fans is low—and operating cost is almost negligible. Above, a "Buffalo" Belt-Air Fan maintaining fresh air in pump room. For smaller-area "spot" ventilation, the "Buffalo" BREEZO is ideal, while the Heavy-Duty Type "NV" Breezo is designed to work against up to ¼" duct or other resistance. Write for Bulletin 3222-F for all the facts on these practical, universally-popular fans.

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SUSPENDED RAIL and two-wheel truck supports rolling ladder that can be easily moved along a line of high shelves, providing ready access to upper storage areas and promoting safety by reducing slippage hazard.

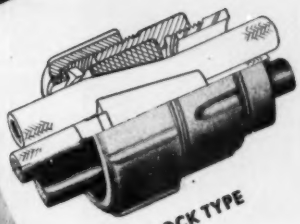
This permits maximum utilization of wall space for storage purposes and, since the ladder is supported from above, the possibility of slipping is absent. The overhead track is bolted to overhead floor timbers and the double-wheeled truck operates along the flange of the angle-formed runway. The ends of the track are terminated by raised stop-plates that prevent the rolling truck from slipping off the rolling surface.

FLOOR DIP TANK is out of the way, yet handy for dipping operations at Dowzer Electric Machinery Works, Mt. Vernon, Illinois. Unit is 48 inches deep; 40 inches in diameter; holds approximately 125 gallons of insulating varnish; has two covers—one over the tank and a second one flush with the concrete floor.

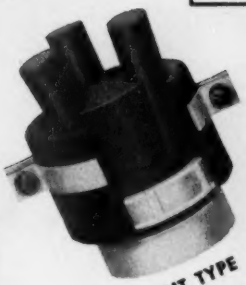
3 WAYS TO MAKE SURE CABLES STAY PUT!

National Electrical Code paragraph 3014 specifies intervals at which cable supports must be used in vertical raceways.

CONDUIT TYPE



LOCK TYPE



SPLIT TYPE

When you're looking for a better way to hold cables fast, protect connections against pull or vibration—install O. Z. Cable Supports.

WHY?

BECAUSE O. Z. makes the *only* cable supports with one-piece impregnated maple plugs, machined to the exact wire size.

BECAUSE there is an O.Z. support for installation before or after pulling wire.

BECAUSE the serrated O. Z. liner provides a *positive* grip when plug is wedged home.

BECAUSE you can choose from three basic types the *best* support for your job—

1. **CONDUIT TYPE** for fast, easy installation on vertical runs. Screws directly on conduit. Malleable iron body grooved for tightening with screwdriver.
2. **LOCK TYPE** for use in *any* position. Threaded collar pressing against plug assures vibration-proof support under all conditions.
3. **SPLIT TYPE** for quick changeover jobs where cable is already installed. Body halves placed around cable, steel band fastened, and assembly placed on top of conduit.

There are thousands of O. Z. products designed to help you put power where you want it, and your O. Z. distributor is the man to see about them. Send for illustrated catalog.

And Remember—They're O. K. If They're O. Z.

CONDUIT FITTINGS • CABLE TERMINATORS • CAST IRON BOXES
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incorporate the rigid specifications of Architects, Electrical Engineers, Contractors and Maintenance Men. They are designed to provide maximum operating efficiency; easier installation and maintenance; durability and beauty over a long service life; and lower installation, maintenance and operating costs. "White Knight" Luminaires—available for 48, 72 and 96 inch slimlines—are fully described in Bulletin WK 2-4. Write for your copy, today.

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Another outstanding 2-Lamp Slimline Luminaire is the "Dreadnaught." Available in all lengths to accommodate all Slimline Lamps from 42", to 96". Write for descriptive literature.

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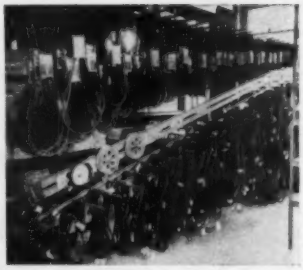

LARGE CAPACITY and relatively small floor area requirements are features of this V-belt storage and display rack at Phoenix Electric Co., Mansfield, Ohio. Unit holds approximately 1,200 belts ranging from 26-in. to 158-in. size.

Unique Rack For V-Belt Storage

The problem of providing adequate storage and display facilities for a substantial stock of V-belts has been solved by the construction of a simple, space-saving rack at the Phoenix Electric Company, Mansfield, Ohio. C. A. and R. A. Bonham, father and son operators of the repair shop, constructed the rack of 1½-inch steel tube; designed it to occupy only 48 square feet of floor space and accommodate approximately 1,200 belts.

The frame of the 16-foot long, free-standing rack is rectangular in shape. The two 7-foot upright members are welded to the center of 3-foot lengths of tubing that rest on the floor. This inverted-T construction at the base prevents tipping. A length of 1½-inch tubing is mounted at an angle between the uprights; serves as a brace and support for the "arms" on which the belts hang. The angle of incline, and point of connection at each upright, is determined by the shortest (26-inch) and longest (158-inch) belts that are stocked.

Both the horizontal and inclined members of the rack have 24 double "arms" consisting of a short section of conduit welded to each side of the pipe member. Each double arm holds 24 belts (12 on each side).

Tie braces between the arm supports add to the rigidity of the rack and provide a convenient mounting for the belt-matching device installed just above the inclined member. With this unit, Bonham can match new belts with the customer's old ones and be certain that the proper size is offered as a replacement.

V-belts mounted to the lower member range from the smallest at the left side of the rack to the largest at the right. The reverse sequence applies to the top member.

IDEAL Wire-Nuts®

Patented, No. 1,933,555

(THE SOLDERLESS, TAPELESS WIRE CONNECTORS)

By the Industry's own standards

THE BEST WIRE CONNECTORS

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Spring Insert is exactly right size and shape to twist and thread wire ends automatically. Precision built to .001" tolerance!
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Spring Insert is proper length to allow ample clearance for wire ends
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STRONGER
Wire ends are held in a vise-like grip that cannot pull loose or shake loose. A "Wire-Nut" joint is stronger than the wire itself!

Contractors' sizes 74B and 76B listed as "Pressure Cable Connectors", suitable for all types of branch circuit wiring.

Here's why it costs you less to use the Best!

IDEAL "Wire-Nuts" are manufactured, inspected and tested to the highest standards in the industry. The "Wire-Nut" Spring Insert is tested for wire diameter—dynamometer-tested for tensile strength—precision wound to proper conical shape—and sample checked to .001" tolerance! The "lifetime" plastic shell is submitted to a hot oil bath (300° F.) for one hour. In all, IDEAL "Wire-Nuts" must pass 9 different inspections and tests . . . For you, this *extra* care in manufacture pays off many times over. *You* get the best, most permanent wire joints that it is possible to make by *any* method—at an average cost of 1c per joint! It's no wonder that more contractors prefer IDEAL "Wire-Nuts" than any other method of making wire joints. They know from experience it costs them less to use the best—IDEAL "Wire-Nuts" . . . Be safe—be sure—for every wire joint use only IDEAL "Wire-Nuts". Every one has the name IDEAL plainly molded in the shell—always look for it!

Look for the METAL-EDGED Package

IDEAL "Wire-Nuts" are packaged in metal-edged protective boxes. The red, yellow and black package is instant identification of genuine IDEAL "Wire-Nuts". Look for it!

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IDEAL INDUSTRIES, Inc.
SYCAMORE, ILLINOIS

IDEAL wiring tools make wiring jobs EASIER - FASTER - CHEAPER

3 TOOLS in 1

IDEAL Fish Tape, Reel and Puller

Cuts fishing time in half! Makes it easy to bring tape through conduit. Gives BIG pull and sure grip. Keeps tape always under control, free of kinks and bends. Tape can't spring loose, is always in the reel or in the conduit. Workmen avoid "live" parts. Six sizes—50 to 200 feet.

EASIEST WAY TO CUT B-X

B-X ARMOR CUTTER

Just place cable in jaws, squeeze handles—then twist cable and pull it apart. No damaged insulation, hacked or torn fingers. Cuts anywhere along length of cable. For all B-X Cable, No. 10, 12 or 14 (two or three-wire).

MAKES FUSE PULLING SAFE

"Safe-T-Grip" FUSE PULLERS

Eliminates danger of pulling and replacing fuses by hand and the bending of fuse clips through improper removal. Ideal for handling "live" electrical parts. Formed to fit the fingers — assures positive, non-slip grip. Three sizes for all common fuses.

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☐ Send catalog data on Fish Tape, Reel and Puller, B-X Cutter and Fuse Puller

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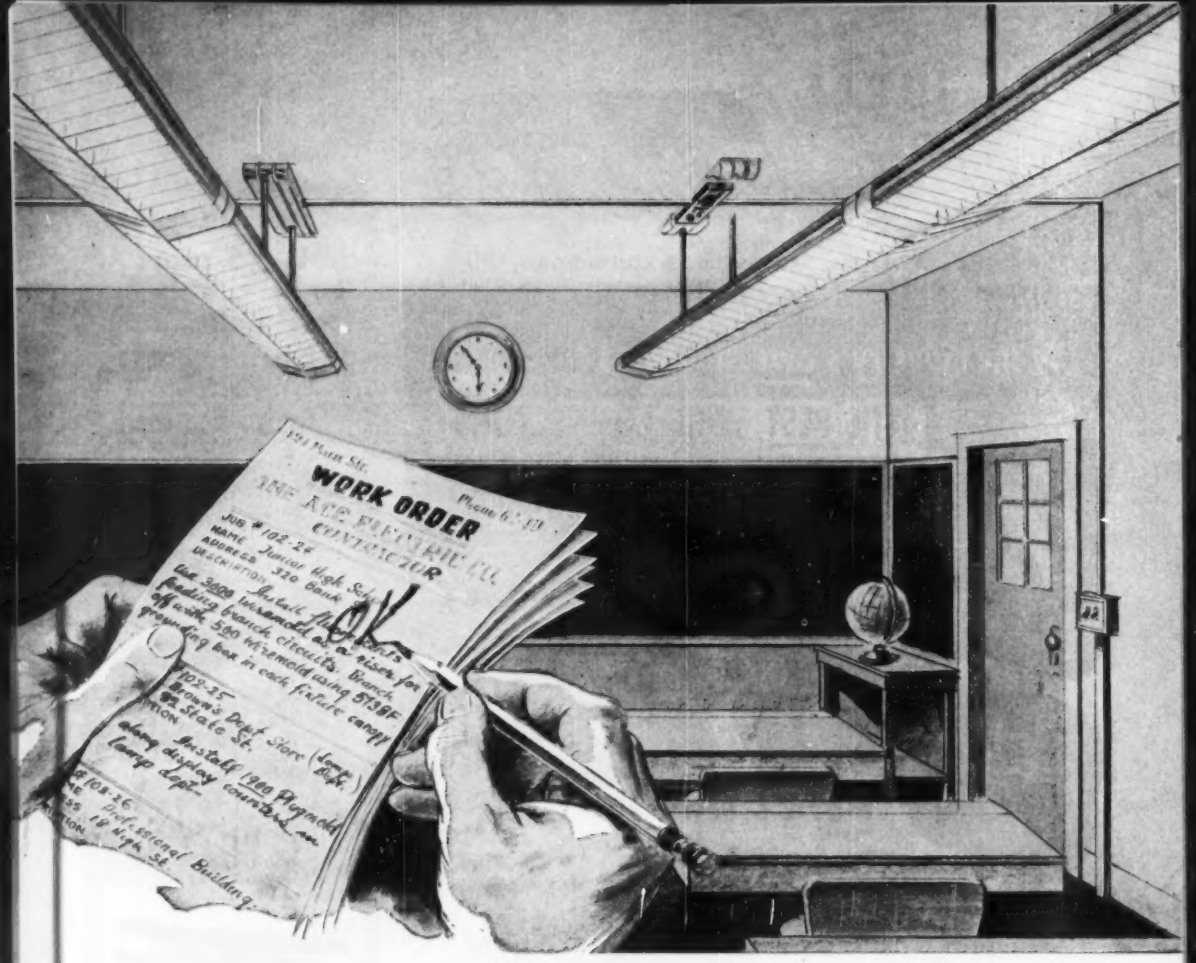
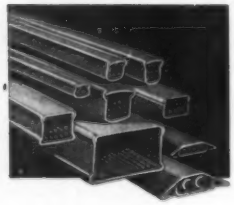


On the surface...*no muss...no fuss!*

To provide more adequate electrical service in terms of increased lighting and power circuits is one of the important modernization problems constantly facing building owners and managers.

Wiremold is the simple, efficient answer to such problems . . . often less costly . . . and in many cases the only practical solution. Regardless of whether the job is large or small, simple or complex, the nine interconnecting Wiremold surface raceway systems, and complete range of fittings, enable the wireman to handle every job faster, easier. Important, too, it means greater opportunity for jobs that might not otherwise be considered . . . a neat, finished installation that always has customer approval.



That's why we say . . . *Wiremold is the best way to wire most buildings, the only way to wire many buildings.* Write today for your copy of Wiremold Catalog and Wiring Guide No. 18.

Know your **WIREMOLD**

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In the News

NISA CONVENES IN BOSTON

Technical discussions, forums, inspection trips and fellowship highlighted the 17th annual motor repair convention.

The 17th annual convention of the National Industrial Service Association—staged in Boston's Hotel Statler June 4th to 7th—was a fast-paced, practical, cooperative inter-industry success. It attracted 530 delegates from 34 states and 2 provinces, spanning the country from coast to coast and border to border. Planned by an energetic executive committee, the convention encompassed a wide range of interests, with business sessions, inspection tours, open forums, committee meetings and an excellent social program.

The first business session, called to order by chairman John E. Launder, Independent Electric Machinery Co., Kansas City, Missouri, introduced four speakers to NISA delegates. First to speak was Alfred C. Neal, vice president and director of research for the Federal Reserve Bank of Boston. He was followed by Robert Kaska, Chicago Electric Co., Chicago, Ill.; Paul L. Keating, Electrical Installation Co., Cambridge, Mass., and J. Arthur Turner, Tampa Armature Works, Tampa, Fla.

Mr. Neal's discussion briefly sketched the economic background of the convention territory under the title, "Business Progress in New England", presenting a clear picture of industrial growth, employment and business trends. Of particular interest was his analysis of the New England electrical and instrument fields which, during the past decade, have grown 118—and 64-percent employment-wise.

Bob Kaska's appearance was as a pinch hitter for Joseph F. Ferrari, Excel Electric Service Co., Chicago. His topic, "Competent or Incompetent Competition", brought out the points that many customers go price shopping without considering the quality of the finished job. And, "since insulating varnishes can be purchased from $1.50 per gallon up to $15.00, and magnet wire, slot insulation, care of installation, thoroughness of cleaning and accuracy of testing can be varied within wide limits, it is possible to fit a service job into any price level and still make a profit." When motor shop operators cut quality without cutting the price, they are selling their customers short. Moreover, when they cut profit, that is, maintain quality without charging for this extra service, they are a detriment and liability to the industry and economic stability of a community. Cadillacs and Chevrolets are both good cars. But they obviously incorporate different qualities and appeal to different price levels. Only when price and quality are equal can we be assured of competent competition.

"THE GANG'S ALL HERE" is the theme of L. J. Greenfield, Motor Power Co. of N. Y., Inc.; W. J. Engel, T. B. McCabe Co., Philadelphia; Samuel Schaffer, A. Werby & Co., Boston; Bob Ward, Electric Motor and Repair Co., Raleigh, N. C.; Harry Chiswick, Ed Shenker and Dan Chiswick (last three from Chiswick Electric Motor Co., N. Y. C.)

A CLEVER STORY, told by Paul Leicht, Empire Electrical Co., Empire, is appreciated by Ernest W. Bogusch, also from Empire; B. L. Whittemore (registration chairman, B. L. Wittemore Co., Framingham, Mass., and Philip E. Stultz, Stultz Electric Works, Westbrook, Me.

Kennametal Masonry Drills

ZIP through cement, brick, slate, marble
New trouble-free drill works in any direction, goes to any depth (up to 10 inches), drills faster... can save on time and cost.
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Kennametal Tri-Point Rock Drills
..20% to 30% more speed in ROCK
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Super-tough Kennametal cemented carbide cutting edge resists wear, stays sharp — UP TO 100 TIMES AS LONG.

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If your supply house cannot supply you, write:

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Please send me FREE Folders K-109 and K-111 on how time and money can be saved on ROCK and MASONRY drilling jobs, and also particulars about Kennametal drills.

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New Kennametal Tri-Point ROCK drill hammers through the most abrasive sandstone, concrete aggregate, and HARD ROCK. Brute Strength enables it to take terrific poundings, shocks and impact.

Its wear-resistant Kennametal cutting edge stays sharp up to 100 times as long — gives up to 30% faster drilling speed. Diameters are ⅜" to 1"; lengths, 7¾" and 12". Buy money-saving Kennametal Tri-Point ROCK Drills at your supply house.

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WORLD'S LARGEST MANUFACTURER OF CEMENTED CARBIDE DRILLING TOOLS

PRESIDENT-ELECT Ed Grant, Tennessee Electric Motor Service, Nashville, Tenn., and NISA treasurer C. R. Durand, H. N. Crowder Jr., Co., Allentown, Pa., renew personal ties.

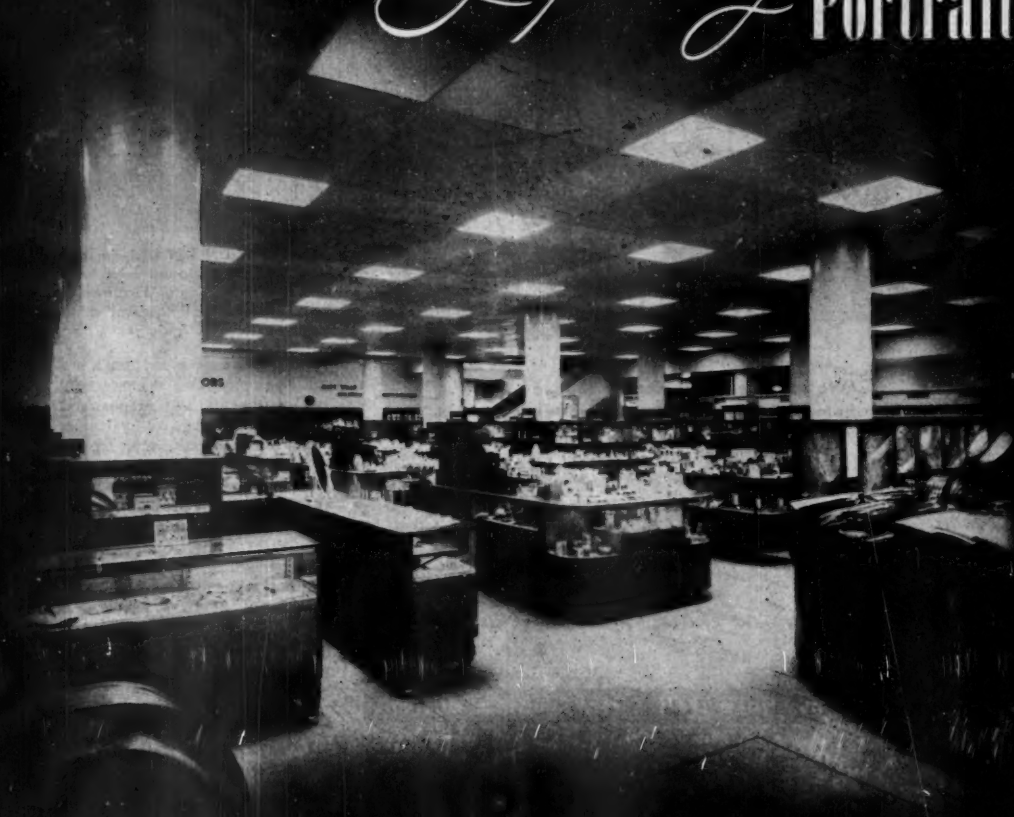
Paul Keating, discussing "Basic Repair Shop Costing Practices", pointed out that many shop owners undercut their competitors through ignorance; not through sharp figuring or economic operation. "This is unhealthy for the individual shop and for the industry as a whole", he said. This ignorance overlooks the fact that the cost of a job not only includes direct labor, materials and profit, but many hidden costs as well—such as shop maintenance, cleaning, inventory waste, damaged goods, delays in shipping, accidents and absence of employees. Failing to appreciate these factors is business stupidity.

"A Review of Rewinding Times", by J. A. Turner was based on time studies made in connection with polyphase motors and, in discussing the subject, he analyzed materials handling equipment, cleaning, painting, assembly, dead inventory stock, coil-forming methods, shipping practices and selling. To illustrate each point, Mr. Turner described the methods used in his own shop, and gave the reasoning behind its use. To remain in competition with manufacturers of new equipment, repair and service shops must never sacrifice quality. "Our aim is not how much we can get for what we give, but how much we can give for what we get".

The second business session was chairmanned by Robert B. Turner of the Johnson-Turner Electric Repair and Engineering Co., Ltd., Windsor, Ontario. He introduced Samuel Heller, Consolidated Electric Motor Co., New York City; Dean William S. Sutcliffe, College of Business Administration, Boston University, and Frank W. Willey, Willey-Way Electric Co., Cincinnati, Ohio.

Speaking on "Meters, Their Use and Mis-Use", Sam Heller discussed instruments not in the order of their use, but by classes, such as the following: insulation testers, voltmeters, ammeters, ohmmeters, and speed indica-

A Permaflector Lighting Portrait



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"He says he wants double cheese to help wire anything but P&S outlets!"

P. S. P & S devices have been specified by wise architects for over sixty years. One good reason, as anyone knows, is that P & S devices last longer, are easy to wire, and therefore cost less to install.

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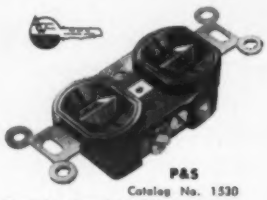
here is an easy-to-install T-slot duplex outlet

Large-head No. 8 binding screws — spaced far apart — take No. 10 wire easily . . . one screw on each side backed out to speed wiring . . . plate screw hole tapped in strap — no rivet to twist or turn . . . washer type plaster ears . . . compact one-piece bakelite body is recessed at the ends to allow more room for cable clamps and locknuts . . . phosphor bronze double-grip contacts are built to last. Rated 15 amps, 125 volts; 10 amps, 250 volts, this typical P&S outlet has Underwriters' approval, meets or exceeds all Federal and R.E.A. specifications. For fine materials, sturdy construction and easy, time-saving installation — depend on P&S.



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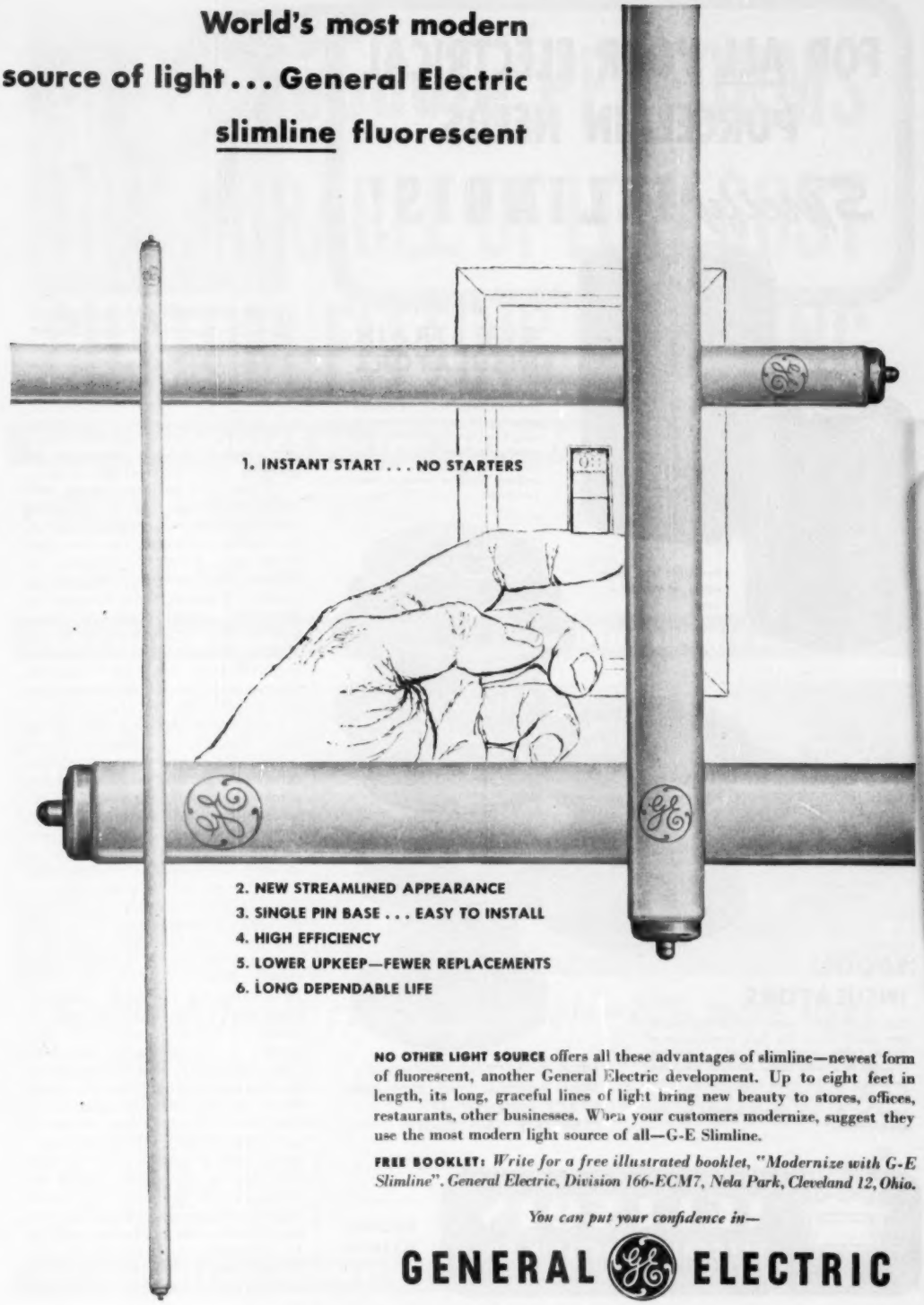
CONVENTION DETAILS are checked by publicity chairman John Reddington, J. J. Reddington Electric Service, and general chairman Fred S. Ferris, Northeastern Electric Co., Boston,

tors. He explained numerous uses not originally planned for certain types of instruments and emphasized that accurate test data is valuable only when it is correctly interpreted.

Dean Sutcliffe's, "Fifty Years in Review" covered the growth of democracy during the past half century, economic advances, social security legislation, redistribution of population and employment, growing mechanization and our tax program. "Governmental subsidation of farm produce, retirement funds, medical legislation, unemployment benefits and old age pensions are being advocated by many as steps toward security", he said. "But such security, when it makes idleness attractive, promotes regimentation and kills incentives to work and save for ourselves, can only end in a socialistic state. Prosperity cannot be bought by doling out public funds in the form of deficit spending. To restore initiative, we must recognize that government spending has to be paid for by someone sometime. Our tax system should include incentives for high—not low—production. And it is the duty of business to educate the public in the fact that private enterprise is essential for democratic survival."

Frank Willey's discussion on the "Effects of the New Wage-Hour Law as Applied to the Motor Repair Shop" was a comprehensive analysis of the law adopted by Congress in 1938 and amended this past year. Taking the provisions in order, he interpreted for NISA delegates the significance of the minimum wage boost, the maximum work week, overtime payrate, compliance with child labor laws, exemptions from the law, advantages of such exemptions, apprentice training, associated taxes, and the present indefinite status of NISA shops as interpreted by the Department of Labor and the law's Administrator.

World's most modern source of light . . . General Electric slimline fluorescent



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2. NEW STREAMLINED APPEARANCE
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5. LOWER UPKEEP—FEWER REPLACEMENTS
6. LONG DEPENDABLE LIFE

NO OTHER LIGHT SOURCE offers all these advantages of slimline—newest form of fluorescent, another General Electric development. Up to eight feet in length, its long, graceful lines of light bring new beauty to stores, offices, restaurants, other businesses. When your customers modernize, suggest they use the most modern light source of all—G-E Slimline.

FREE BOOKLET: *Write for a free illustrated booklet, "Modernize with G-E Slimline". General Electric, Division 166-ECM7, Nela Park, Cleveland 12, Ohio.*

You can put your confidence in—

GENERAL ELECTRIC

FOR ALL YOUR ELECTRICAL PORCELAIN NEEDS

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GUY STRAIN INSULATORS

Manufactured under rigid control standards, from the careful selection of materials through all steps leading to the top quality finished product. Internal stress eliminated through uniform firing at constant temperatures.

Available from large stocks of standard sizes.

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SPOOL INSULATORS

You won't find a better wet process porcelain spool! Here's the right combination of dependable mechanical and electrical strength in a wide range of styles and sizes produced to the usual high quality standards maintained by Illinois. Also manufactured by the dry process method to your specifications.

HIGH DIELECTRIC STRENGTH
HIGH MECHANICAL STRENGTH
EXACT DIMENSIONS
COMPLETE UNIFORMITY

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MACOMB, ILLINOIS

ENTERTAINMENT is on the minds of Dave Sandman (right—entertainment chairman), Sandman Electric Co., Boston, and Chris F. Dulsen (one of his "boys"), Central Electric Co., Cambridge, Mass.

A resolution addressed to Congress was adopted by those assembled, requesting clarification of this status.

At the third business session, with Leonce Bonnecaze, Jr., Best Electric Co., New Orleans, acting as chairman, five speakers addressed the convention. They were Frank L. O'Brien, Jr., O'Brien Machinery Co., Philadelphia; Lynn F. Hummel, Glow Electric Co., Cincinnati; James I. Meehan, International Shoe Co., Manchester, N. H.; William Henry, Henry Electric Co., Saginaw, Mich., and John E. Launder, Independent Electric Machinery Co., Kansas City, Mo.

Speaking on "Services Used Equipment Dealers Can Render Repair Shops", Mr. O'Brien pointed out that, collectively, the used equipment dealers across the country have a stock exceeding most manufacturers and, by pooling these resources, NISA members are offered a complete line of valuable, reconditioned equipment for a fraction of their original cost.

A "Rebirth of Selling" was the plea of Lynn Hummel, who stated that selling is based on two things; first, what you can do for a customer and second, proving that you can do it. In defining his thesis, Mr. Hummel stated that, "It is only fair that the pitfalls of selling be mentioned. Remember to 1) stay on the customer's side, making sure that the sale is for *his* benefit, not your own. 2) Avoid the use of super-technical terms for, to those not in the industry, our terms are often foreign. 3) Avoid arguments with a customer by agreeing with him—on the surface. Follow the "yes . . . but" principle. 4) Ignore customer statements designed to bait the salesman into a defensive attitude. 5) Ask questions. It permits the customer to express his wishes, adds to the salesman's general information,

ONLY MITCHELL module PERFORMS THIS MIRACLE OF LOW COST CUSTOM-FITTING LIGHTING

REG. U. S. PAT. OFFICE

These 4 MODULES are the "BUILDING BLOCKS" of LIGHT

A — 4 14-Watt T-12 15" Type F Lamps

B — 32-Watt 12" Circline Lamp, and 1 PAR Spot or Flood Lamp

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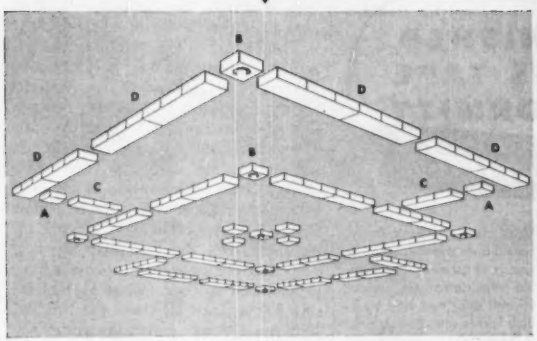
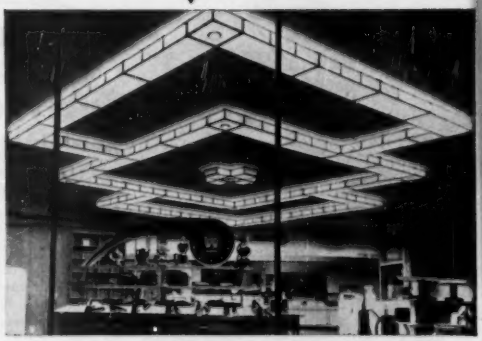
D — 4 75-Watt T-12 425 Milliamp Slimline Lamps

They fit together like THIS—for lighting magic like THIS





50,000 different patterns possible—20% more light

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Only MITCHELL makes MODULE

There's nothing in lighting like MODULE. It *custom-fits* and "grows" with every lighting need; it delivers *more* light; it *stays* beautiful, now; it costs *no more* than ordinary fixtures. If you haven't *all* the MODULE facts, *write today.*

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YOU SELL module INSTALLATIONS WHEN YOU TELL THIS SELLING STORY

Over 150 different sizes and models!

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—FOR EVERY COMMERCIAL AND RESIDENTIAL REQUIREMENT!

Specifying Chelsea Fans for every installation is one sure way to proper ventilation. There's a Chelsea model for every requirement—industrial, commercial and residential—and each type is certified as to performance in accordance with the Standard Code of the Propeller Fan Manufacturers Assn.

Industrial Fan Type IND

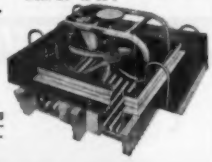
For large general area ventilation. Moves large volumes of air under pressure. Scientifically designed blades overcome high resistance in hoods and ducts. "V" belt drive. Sizes from 24" to 60".

All-Purpose Fan Type BB

For removing smoke, steam, heat, fumes, etc. Heavy duty (direct drive fan for continuous operation. Recommended for use against static pressure and in duct work. One piece panel and orifice, lightweight, simple to install. Sizes from 19" to 36".

Chelsea Comfort Cooler Type EV

Designed for attics of low headroom, this Chelsea package unit is complete with automatic ceiling louver, brackets and springs, canvas boot, etc. Quiet in operation, economical to install. Sizes 24" to 48".



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Contains all the information you need to make ventilating and cooling installations in factory, store, office or home—selection of proper fan, installation hints, etc. No obligation—write Department EC.

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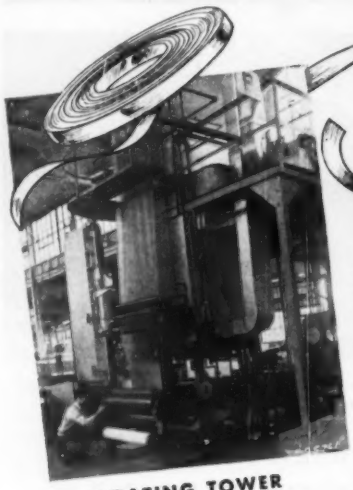

COATING TOWER

Insures uniform saturation; cures silicone varnishes at 650°F., conventional resin long-life synthetic varnishes at 350°F. Designed, constructed and used solely by National Electric Coil Company.

VARNISHED GLASS TAPE UNIFORMITY *Insured*

Since varnished glass cloth, in both sheet and tape forms, is used only when specially-effective insulation is required, uniform quality is of special importance. To insure this uniformity, National designed and built a coating tower which forces the varnish into the cloth, meters it and cures it with automatic accuracy.

The varnish becomes an integral part of the coated cloth. Weight, thickness and percentage of component parts are precisely maintained.

Conventional and silicone coated glass cloths are available in rolls of any width up to 36". Mica-Glas (trademark) sheets and tapes, fabricated from these cloths and hand-laid mica splittings, are also available.

Send for a sample of the varnished glass cloth best suited to your needs.

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ELECTRICAL ENGINEERS . . . MAKERS OF ELECTRICAL COILS AND INSULATION

REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

NISA DIRECTORS C. J. Cannon, Nimmo Electric Co., Detroit, and Mike F. Zack, Zack Brothers Electric Co., Mason City,, Iowa, helped welcome the 530 convention delegates.

frequently suggests new approaches to breaking sales resistance. 6) Don't talk too much, for it is as easy to kill a sale as to promote one by word of mouth."

Citing numerous examples for promoting "Safety in the Shop", James Meehan stated that "One of the greatest overhead costs to business is personnel turnover. We spend money to maintain equipment, yet frequently are guilty of neglecting the maintenance and safety of workers. By checking personnel maintenance, through the provision of goggles, safety clothing, guards and other protective measures, both machines and operations will be kept at higher levels of efficiency."

The "Relative Cost and Profit Margin of Silicone (Class H) Rewound Motors", as presented by William Henry, included a step-by-step description of rewind procedures, actual costs of materials and performance data. In summation, he said that, "In some cases a little salesmanship is involved because there are still a lot of people who lack information about silicone insulation. But that salesmanship is a service to the customers, for tests have proven that silicone (Class H) insulation has at least 10 times the life and 10 times the wet insulation resistance of Class B insulation. By making this new class of insulation available to our customers, we are performing a service that is profitable to both the customer and ourselves."

"Job Classification" recommendations for NISA, discussed by John Launder, included both office and shop departments, from receptionist and telephone operator through billing and engineering staffs to executive personnel, and from receiving clerk through testing and cleaning procedures to winding, dipping and baking. Detailed descriptions of their responsibilities and their importance were brought forward and suggested methods for

You wouldn't hunt rabbits with a cannon!

CONTACTOR—Device for repeatedly establishing and interrupting an electric power circuit (NEMA definition).

RELAY—Device operative by variations of one circuit to effect operation of device in same or other circuit (NEMA).

... So why use a BIG contactor to do this relay's job?

Some control users are hunting rabbits with a cannon . . . when they use a power contactor to do a small relay's job. Sometimes, this is done as an escape from previous troubles with inadequate relays.

Nevertheless, it is poor engineering! When you add size you add weight . . . and also wear and tear.

Why pay extra money and waste panel space with a power contactor, when over 1,000,000 Allen-Bradley solenoid relays have proved themselves entirely adequate for any relay service.

Better investigate why Allen-Bradley relay users enjoy such trouble-free performance. Just ask for Bulletin 700. Allen-Bradley Co., 1316 S. Second Street, Milwaukee 4, Wisconsin.

A-B

ALLEN-BRADLEY

BULLETIN 700 RELAYS

QUALITY

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Over 1,000,000 ALLEN-BRADLEY RELAYS

in precision control applications

Ten hundred thousand relays are a lot of relays . . . all at work on machine tools and other responsible jobs . . . that's the success story of Allen-Bradley Bulletin 700 Solenoid Relays since they were introduced, eighteen years ago. Ask about them . . . anywhere . . . and you will find Bulletin 700 Solenoid Relays are dependable . . . accurate . . . consistent . . . long lived . . . and trouble free.

Don't buy a contactor to do a relay's job. Standardize on Bulletin 700 Relays . . . and be safe.

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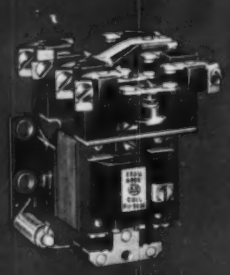
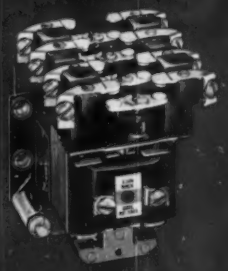
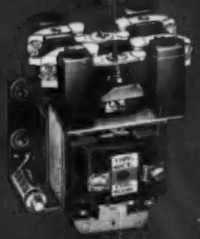


Bulletin 700—Type [illegible] 200, 2 Pole Mechanically Held Relay.

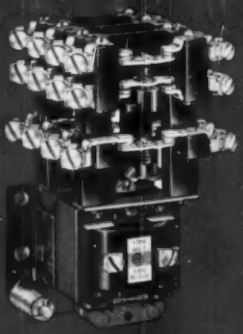


Bulletin 700—Type [illegible] 400, 4 Pole Solenoid Relay.

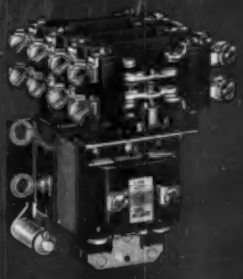
Bulletin 700—Type CL 200, 2 Pole Low Coil Current Relay.



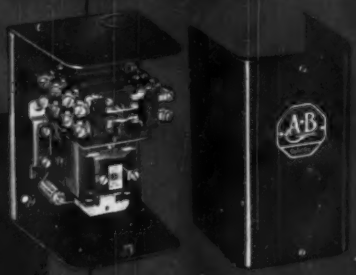
Bulletin 700—Type [illegible] 200, 2 Pole Solenoid Relay.



Bulletin 700—Type BX 840, 8 Pole Universal Solenoid Relay.



Bulletin 700—Type BX 440, 4 Pole Universal Solenoid Relay.



Bulletin 700 Relays are available in NEMA Type 1, 4, and 7 enclosures, or without enclosures for mounting on special panels.

ALLEN-BRADLEY
BULLETIN 700 RELAYS
QUALITY

TWO MORE DIRECTORS, G. E. Jones, G. E. Jones Co., Inc., Amarillo, Texas, and Rudolph A. Scherer, Scherer Electric Co., Indianapolis, Ind., were pleased to learn that NISA membership now exceeds 1100.

recording these classifications were included.

An entire day was devoted to open forums, with parallel sessions running from 9:30 a.m. to noon and from 2:30 to 5:00 p.m. These were practical shirt-sleeve bull-sessions, with frank interchanges of ideas and methods. These forums, more than any other single fact, emphasized the unusual cooperation existing between NISA members.

Topics for these forums included management, large and small motor problems, overheat protection, sales-service, shop methods, transformers, used equipment and office procedure. Chairmen were William H. Braunlich, J. P. Pilmer, Joseph H. Previty, Frank Willey, C. J. Covington, Frank O'Brien, Jr., and Selden High. Vice chairmen included C. R. Durand, G. E. Jones, Hillrie Q. Griffith, T. M. Russell, H. E. Grant, F. M. Miekle, D. Ward Rust, R. E. Ward, M. F. Zack and Paul L. Keating. Also scheduled during this period were "Sales Survey Reports" by Selden High and a discussion on "Overheat Protection of Electric Motors" by E. F. Kurty, Spencer Thermostat Co.

Inspection tours, arranged for the afternoon of June 6th, included trips to NISA Shops in Greater Boston (see May, 1950 issue of E. C. & M.); the General Electric Repair Shop in Medford; Westinghouse Electric and Manufacturing Co., South Boston, and the Massachusetts Institute of Technology.

NISA activities during the past 12 months were reviewed at Monday's luncheon by Robert E. Ward, president, Electric Motor & Repair Co., Raleigh, N. C., retiring NISA president. His address, "My Year", mentioned association growth, committees, activities, director actions, personal observations on the numerous section gatherings and motor shops he had

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Sure she's mad!

And you'd be too if you were trying to handle pesky (to her!) intercom messages in addition to important outside calls. Stop wasting *her* time and *your* money. Get real efficiency by installing a Couch Private Phone system . . . free outside lines . . . replace regular phones used only for intercom calls . . . reduce unnecessary calls. From 2 to 50 phones, Couch has the system right for your needs. Write for information today.

Type 52
Four Button Model

COUCH AUTOPHONE SYSTEM

. . . with simplified dialing

30 or 50 line systems . . . "one shot" dialing saves time, eliminates manually operated switchboard . . . simple, rugged, inexpensive.

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DEPT. 807 NORTH QUINCY 71, MASS.

Private telephones for home and office . . . hospital signaling systems . . . apartment house telephones and mail boxes . . . fire alarm systems for industrial plants and public buildings.

FULLMAN Latrobe PRODUCTS

FLOOR BOXES WIRING SPECIALTIES

For Fast, Easy Installation

For Sure Service—"LATROBE"

"Latrobe" Floor Boxes and Wiring Specialties are designed straight and to the point. Their fewer parts make for quicker installation, trouble-free performance.

"Latrobe" Products are convenient and practical. They save time, trouble and money.

No. 284 Nozzle With No. 200 Cover Plate

This Duplex Receptacle Nozzle is neatest and most compact fitting on the market. Furnished with either ½" or ¾" brass pipe extension.

No. 252-R Two Gang Adjustable Floor Box

Sturdy and efficient with No. 203 Receptacle in one section. One Cover Plate has ½" Flush Brass Plug; other has 2" Flush Brass Plug.

No. 330 Tom Thumb Utility Outlet

A handy general purpose outlet for use in wood floors, mantels, baseboards, show windows, etc. Quickly installed without special tools and without marring woodwork finish.

No. 110 "Latrobe" Watertight Floor Box

The simplicity and directness of design of the 110 saves 15 to 20 minutes installation time per box. Results in safer job with more wire space inside. 203 Receptacle. Cover Plate, 3 ½" diam.

Keystone Fish Wire

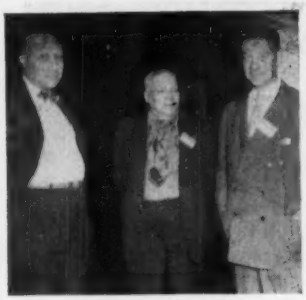
Finest grade flat steel wire perfectly tempered for strength and safety. 100, 150 and 200 foot coils in ten sizes—lightest work to heaviest power wiring.

Sold Only Through Wholesalers

"Bull Dog" BX Cable Staples

Their top quality makes these staples safe and dependable. Packed in box, carton, keg and barrel. Popular everywhere.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA



A PAUSE BETWEEN SESSIONS is enjoyed by Milton Benjamin, Empire Electric Co., Brooklyn; M. Friedkin, Electric Enterprise Co., New York City, and Charles H. Stark, Stark Electric Co., Baltimore, Md.

visited, and trends in the industry. He was followed on the rostrum by Fred B. Wipperman, Executive Secretary of NISA, who stressed many of Bob Ward's points by citing facts and figures compiled by the national office.

At the final general gathering—the annual banquet—NISA's president-elect, H. E. Grant, Tennessee Electric Motor Service, Nashville, Tenn., accepted the gavel and responsibility of his new office. He was followed by Harold G. Hoffman, New Jersey's former governor.

The convention was a working gathering. But relaxation was not altogether neglected, for a full social program included two dinner-dances, historic and shopping tours, the famous Boston "Pops" Concert, a baseball game and canasta party.

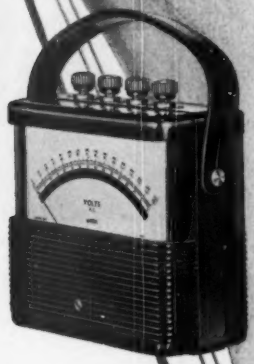
Convention arrangements were under the direction of Chairman Fred Ferris, Northeastern Electric Co., Boston; Al Elson, Jr. (program), New England Machine and Electric Co., Pawtucket, R. I.; B. L. Whittemore (registration), B. L. Whittemore Co., Framingham, Mass.; F. W. Wipperman (exhibits), NISA headquarters; Harry Bedig (reception), Electric Maintenance Co., Boston; D. Sandman (entertainment), Sandman Electric Co., Boston; H. Caddy (transportation), Andren-Myerson Corp., Boston, and John J. Reddington (publicity), J. J. Reddington Electric Service Co., Boston.

Walter Sturrock Named I.E.S. President

Walter Sturrock, of Cleveland, O., has been elected the 46th president of the national Illuminating Engineering Society by its more than 7000 members, it was announced recently.

Sturrock, head of the engineering

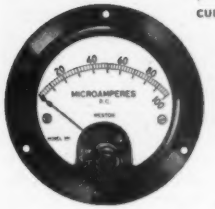
TO KEEP Ahead of Trouble



Self-shielded, easily read, Weston Model 901 Portable Instruments tolerate wide temperature fluctuations, stay accurate to ½ of 1%.

When the warning flags are flying it pays to be prepared, at sea or ashore. To keep ahead of trouble on your electrical equipment, rely on Weston Instruments to warn of approaching trouble . . . to isolate circuit faults . . . to assure trustworthy reports. Weston Electrical Instrument Corporation, 672 Frelinghuysen Avenue, Newark 5, New Jersey.

For accurate circuit analysis, use the ultra-sensitive Weston Model 785 Industrial Circuit Tester. It provides 28 AC and DC voltage, current and resistance ranges.



All AC and DC requirements are met by the extensive Weston line of Panel and Switchboard Instruments.

Measuring voltage and current on insulated or bare conductors is quick and easy with the Weston Model 633 AC Clamp Volt-Ammeter.

WESTON *Instruments*

Albany • Atlanta • Boston • Buffalo • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Jacksonville • Knoxville • Little Rock • Los Angeles • Meriden • Minneapolis • Newark • New Orleans New York • Orlando • Philadelphia • Phoenix • Pittsburgh • Rochester • San Francisco • Seattle • St. Louis • Syracuse • Tulsa • Washington, D. C. • In Canada, Northern Electric Company, Ltd., Powerlite Devices, Ltd.

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

Save You Money and Time

It doesn't require a mathematician to figure the time and money-saving when your Syntron Electric Hammer will drill, cut, chip and point in concrete and masonry, in 1/10th the time it takes to do it by hand.

Their powerful 3600 blows per minute (from 60 cycle A.C.) really speed up the work and cut your costs.

Write for literature

SYNTRON CO.

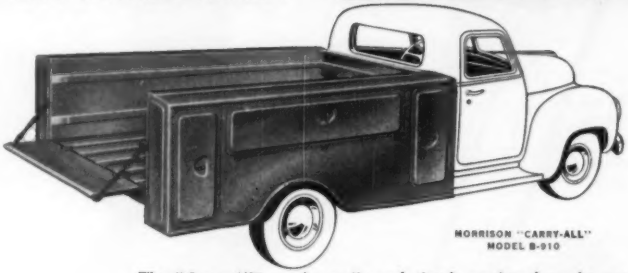
690 LEXINGTON • HOMER CITY, PA.

NEW!

HUSKY, WIDE and HANDSOME

TWO NEW MORRISON *Carry-All*

ALL-STEEL, ALL-PURPOSE SERVICE BODIES



MORRISON "CARRY-ALL" MODEL B-910

The *"Carry-All"* can be easily and simply equipped to the needs of your own business. Optional *"Carry-All"* equipment includes the tailored caravan canvas top, sliding metal roof, overhead ladder racks, pipe racks, pipe vise bracket, material tray, compartment shelves. With these accessories, you can practically custom-design the standard *"Carry-All"* for your own particular requirements!

Write today for FREE LITERATURE on the MORRISON *"Carry-All"*, the new *"Carry-All"* TRAILETTE, *"Carry-All"* SIDE BOXES, and accessories.

MORRISON STEEL PRODUCTS, Inc.

Carry-All Body Division

639 AMHERST STREET • BUFFALO 7, NEW YORK

WALTER STURROCK

publications section of General Electric's Lamp Department at Nela Park, Cleveland, will assume the office at the beginning of the Society's fiscal year next October 1. Active in affairs of the organization for many years, he has been vice president since 1948. This is his 34th year in the lighting engineering field during which time he has authored numerous articles and bulletins on lighting subjects.

Chairman of the Cleveland I. E. S. Chapter in 1928-29, he served as general secretary of the national organization in 1946-48 before being named to the vice presidency. He is a Fellow member of the I. E. S., a member of the Ohio State Professional Engineers, the Society of American Military Engineers, the Cleveland Engineering Society, Cleveland Electric League, Cornell Club, and Mentor Harbor Yacht Club.

Other officers elected are: Vice-President, E. M. Strong, Cornell University, Ithaca, N. Y.; Treasurer, R. F. Hartenstein, Ohio Edison Co., Akron, Ohio; General Secretary, A. H. Manwaring, Philadelphia Electrical & Mfg. Co., Philadelphia, Pa.; Directors: L. A. Hobbs, Smoot-Holman Co., Inglewood, Calif.; Roy A. Palmer, Duke Power Co., Charlotte, N. C.

New Regional Vice-Presidents to be installed in October are: Great Lakes Region, F. C. Winkler, Westinghouse Electric Corp., Cleveland, Ohio; Midwestern Region, Charles N. Laupp, Wisconsin Electric Power Co., Milwaukee, Wisconsin; Northeastern Region, R. G. Slauer, Sylvania Electric Products, Inc., Salem, Mass.; Pacific Northwest Region, K. E. Hollingsworth, Puget Sound Power & Light Co., Seattle, Washington; and South Pacific Coast Region, C. O. Martin, Benjamin Electric Mfg. Co., San Francisco, Calif.

LOUVERED LIGHTING MINUS BULK!

Corning FOTA-LITE combines the advantages of louvers with flat glass

In many lighting installations, high level illumination and uniform brightness control are desirable, but difficult to achieve due to space limitations, cleaning difficulties and problems of decor. For lighting the Barton's Bonbonniere, Corning Fota-Lite afforded the ideal solution. With four-foot panels of Fota-Lite each with 12-40 watt 3500° lamps, excellent foot candle and brightness values are realized. Highlighting is provided by PYREX brand Lenslites illuminated by 150 watt lamps. Every light fixture is recessed.

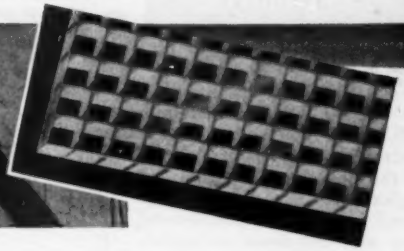
FOTA-LITE is a revolutionary lighting medium. Without bulky, hard-to-clean materials, light distribution is controlled by louvers photographically sealed in a thin panel of glass. Fixtures can be made shallow and dust-tight. Initial efficiency remains unimpaired.

The cell size of Fota-Lite louvers is many times smaller than in conventional louvering materials. This gives it the appearance of an opal diffusing glass. However, vertical light is unrestricted by the clear sections and surface brightness is reduced by the 45° cut-off of the diffusing louvers.

The versatility of Fota-Lite gives it an unusually wide range of application. It is available from leading fixture manufacturers many of whom feature fixtures with FOTA-LITE, ALBA-LITE, PYREX brand Lenslites and CORNING brand Lens Panels.

◁ *Barton's Bonbonniere, New York City*

Designer: Hans Weiss and William Basser, New York City
Fixture Manufacturer: Neo-Ray Products, Inc., New York City
Electrical Contractor: Bigman Brothers, Brooklyn, N. Y.
Glass: Corning Fota-Lite (note photo below) and Pyrex brand Lenslites



CORNING GLASS WORKS **CORNING, N. Y.**

PYREX

Corning means research in Glass

FOR EFFICIENT, ATTRACTIVE LIGHTING...

CORNING ALBA-LITE for diffusion of fluorescent light

CORNING FOTA-LITE for high level illumination

PYREX brand LENSLITES and CORNING brand LENS PANELS for prismatic light control

Technical Products Division: Lightingware, Signalware, Laboratory Glassware, Glass Pipe, Gauge Glasses, Optical Glass, Glass Components, Plant Equipment

For unexcelled dependability and permanence

Specify and Install

AEMCo **TIME SWITCHES**

EQUIPPED WITH SYNCHRONOUS, SELF-STARTING MOTORS

A. C. OR D. C. OPEN OR CAN TYPE WITH TUBE-BASE PLUG-IN FEATURES

Highest quality material and unexcelled craftsmanship combine to make Automatic Time Switches the preference of those who demand *long life dependability backed by an unconditional guarantee.*

Compact, *carefully engineered* Automatic Time Switches have new type, easily set trip levers. Trip levers and dial are visible thru window in attractively finished, tamper-proof case.

Stock Models: Single Circuit, Single Pole, 10 Amperes Capacity to Two Circuit, Four Pole, 45 Amperes Per Pole Capacity. Special models engineered to your requirements.

AEMCo **RELAYS**

Automatic Electric Relays . . . Midget, Interlocking, Circuit Control, Latching, Adjustable . . . are built to exacting high standards to assure unexcelled dependability. Custom built relays designed to your specifications.

Accurately rated Automatic Electric Relays deliver "Diamond Quality" performance.

Write for complete specifications.

LOOK FOR THE DIAMOND SEAL FOR DIAMOND QUALITY

AEMCo *Automatic Electric* MFG. CO.

60 STATE STREET
MANKATO, MINNESOTA

The new Improved Thiel BX Staple drives straight as above—the wood is oak and did not split.

THIEL BX STAPLES

(For Metallic and Non-Metallic Cable)

PATENTS PENDING

SAVE MATERIAL TIME LABOR

THE first real improvement in BX Staples in a quarter of a century. Contractors save lots of worry and waste on the job because Thiel BX Staples are successfully engineered to withstand punishment. They will not bend or squash. The sharp right-angle bends on head drive the staple straight and true. Send for a FREE sample. A trial will convince anyone.

Old Style BX Staple bends like this and splits the wood.

* Sold only thru recognized Electrical Wholesalers *

THIEL TOOL & ENGINEERING CO. 1417 N. MARKET ST. ST. LOUIS 6, MO.

"DOES IT WORK?" That is the question George W. Williams, Superior Electric Co., Springfield, Mass. asks of Lawrence H. McClure, Clark Controller Co., Cleveland, during annual NISA meeting in Boston.

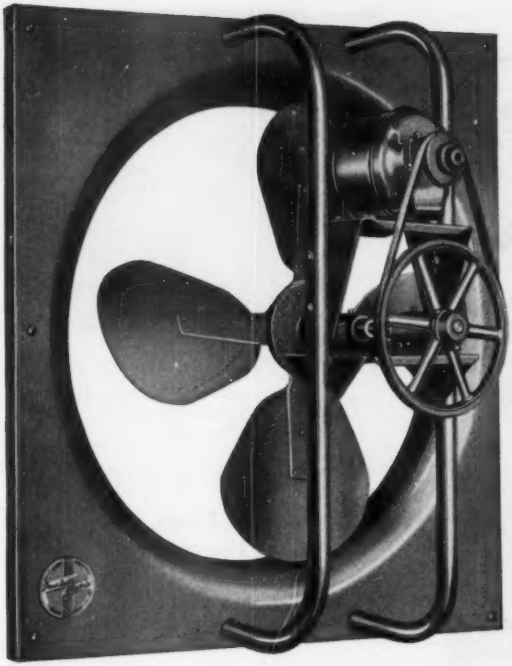
New Managers for Twin-Cities Groups

The Minneapolis Electrical Contractors Association and the St. Paul Electrical Contractors Association each have a new business manager to fill the vacancy created by the resignation of L. A. Clausen, formerly business manager of both groups.

Oscar F. Norgen, electrical inspector for the city of Minneapolis, was appointed business manager of the Minneapolis contractors. He has been in the electrical field since 1938; was chief electrician for the Northwestern Aeronautical Company from 1941 to 1943; spent two years in the Navy during World War II as electricians mate; was appointed electrical inspector in Minneapolis in September 1948.

Dan Gebhart has taken over the business manager's duties for the St. Paul electrical contractors. Mr. Gebhart brings to his new position many years of experience in the field of public and labor relations.

RECEPTION Chairman Harry G. Bedig, Electric Maintenance Co., Boston, greets Clifford C. Emerson, C. M. & H. T. Plummer Co., Portland, Me. during the NISA annual conference.



Peerless Electric

TYPE PAT VENTILATTIC FANS

Attic type ventilating fans for night cooling of homes, stores, clubs, etc., are essential to summertime comfort. Peerless Electric Type PAT Ventilattic Fans, operating silently and efficiently and economically, exhaust summer daytime warm air and pull in cool, fresh air to every room in the house, for comfort in the evening and throughout the night.

FEATURES

MOTORS — Resilient-mounted and sleeve-bearing for quiet operation, automatic thermal overload protected, selected for their long hour duty. Designed by "Peerless Electric," a manufacturer of fans and motors since 1893.

QUIET OPERATION—Belt-driven at slow speed, the perfectly balanced heavy-gauge steel blades operate silently and with high efficiencies. Operation costs only a few cents a day.

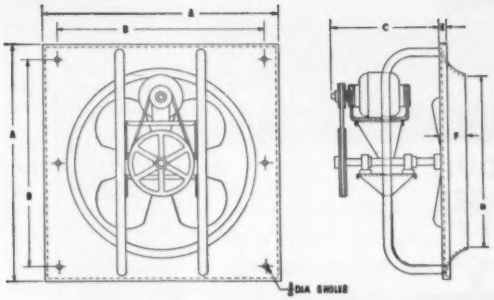
FAN BEARINGS — Sturdy wool-packed sleeve-bearings are rubber mounted. Large oil reservoirs reduce oiling requirement to once a season.

GENERAL CONSTRUCTION—Panel, arms and bearing support assembly completely welded together, heavy adjustable motor support to adjust belt tension, motor pulley variable pitch for changing fan speed, panel with deep venturi for efficient quiet operation — assembly finished in attractive gray Hammerloid baked enamel.

SIZE RECOMMENDATION — Select a Ventilattic fan that will change the air in the house, or space to be ventilated, at least once every minute for Southern climate and once each minute-and-a-half in Northern climates to assure maximum cooling effect.

RATINGS — In accordance with Propeller Fan Manufacturers' Association and American Society of Heating & Ventilating Engineers.

GUARANTEE—Peerless Electric Fans and Motors are guaranteed against defective workmanship or material for a period of one year from date of shipment from factory. All units when shipped are registered and the serial number identifies it immediately for spare parts or duplicates.



FAN PERFORMANCE AND DIMENSIONS

Model	Fan Dia.	Capacity C.F.M.	Capacity C.F.M. 0.1" S.P.	Motor H.P.	High R.P.M. Fan	A	B	C	D	E	F	Shpg. Wgt.
PAT24	24"	4,600	2740	1/6	585	34	31 3/4	15 1/2	24 3/4	1 1/16	3 1/2	90
PAT30	30"	5,450	3280	1/4	520	40	37 3/4	14 3/4	30 13/16	1 1/16	3 11/16	120
PAT36	36"	8,250	5000	1/4	400	46	43 3/8	17 3/8	36 15/16	1 1/16	4	152
PAT36A	36"	9,000	5500	1/3	435	46	43 3/8	17 3/8	36 15/16	1 1/16	4	155
PAT42	42"	11,000	6770	1/3	365	52	49 3/8	17 3/4	43	1 1/16	4 3/16	198
PAT42A	42"	13,100	8060	1/2	435	52	49 3/8	17 3/4	43	1 1/16	4 3/16	215
PAT48	48"	14,500	9000	1/2	375	58	55 3/8	18 3/8	49	1 1/16	4 1/4	250
PAT48A	48"	16,250	10100	3/4	420	58	55 3/8	18 3/8	49	1 1/16	4 1/4	265

Certified Dimension Prints Furnished on Request

THE Peerless Electric COMPANY • WARREN, OHIO

NO. SDA-132

Platform- or wall-mounted air-cooled transformer. 50 KVA, three-phase, 480 to 120/208 Y volts.

peak efficiency

Standard

TRADE MARK

FOR YOUR LIGHTING AND POWER EQUIPMENT WITH STANDARD DRY TYPE TRANSFORMERS

Standard's dry type load center transformers assure correct voltages at point-of-use. Installations are easily made and can be quickly relocated to conform to changing departmental requirements. Consult your Standard representative today. He can show you how Standard transformers save you money by assuring top performance from your equipment.

THE STANDARD TRANSFORMER COMPANY
WARREN, OHIO • OFFICES IN PRINCIPAL CITIES

Carry WATER, GAS AIR LINES, CABLE *at any angle to beams*

with

"EFFICIENCY" CONDUIT HANGER "TYPE F"

On open steel construction, Efficiency "Type F" Conduit Hangers are your best choice for carrying ½" to 2½" pipe and armored cable. Patented radiating ridges and 5-point gripping surface keep pipe and cable suspended dead center, permitting it to be carried securely at any angle to the beam. Write today for Catalog 38-A.

Efficiency ELECTRIC AND MANUFACTURING CO.

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION

EAST PALESTINE, OHIO

"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

W. G. PEIRCE, JR., at right, newly elected president of the National Association of Electrical Distributors and president of Peirce-Phelps, Inc., Philadelphia, receives the congratulations of his predecessor, D. M. Salsbury, president of Westinghouse Electric Supply Co., New York.

N.A.E.D. Elects W. G. Peirce, Jr., President

W. G. Peirce, Jr., president, Peirce-Phelps, Inc., Philadelphia, was elected president of the National Association of Electrical Distributors following the general session of the Association's 42nd Annual Convention held at Convention Hall, Atlantic City, June 12-16.

Also announced at the close of the luncheon and organization meeting of the Board of Governors was the election of Benjamin Gross, Gross Distributors, New York, as vice president and chairman of the Appliance Division. R. M. Johannesen, Johannesen Electric Co., Greensboro, N. C., was re-elected vice president and chairman of the Apparatus and Supply Division.

I. W. Danforth, Danforth Co., Pittsburgh, was elected to the executive committee and Ralph Brown, General Electric Supply Corp., Bridgeport was re-elected to that committee.

The following members were newly elected to the Board of Governors: A. D. Stokes, Stokes Electric Co., Knoxville; C. A. D'Elia, D'Elia Electric Co., Bridgeport; Harry R. Tracy, Tracy and Co., Inc., Providence, R. I.; Raymond Rosen, Rosen and Co., Inc., Philadelphia; Fred H. Dendy, Electrical Wholesalers, Atlanta; J. H. Bragg, Florida Electric Supply Co., Tampa; J. I. Bogden, the B. & B. Electric Co., Cincinnati; J. T. Morgan, Charleston Electrical Supply Co., Charleston, W. Va.; L. E. Barrett, Barrett Electrical Supply Co., St. Louis, and J. R. Thompson, Warren Electric Co., Houston.

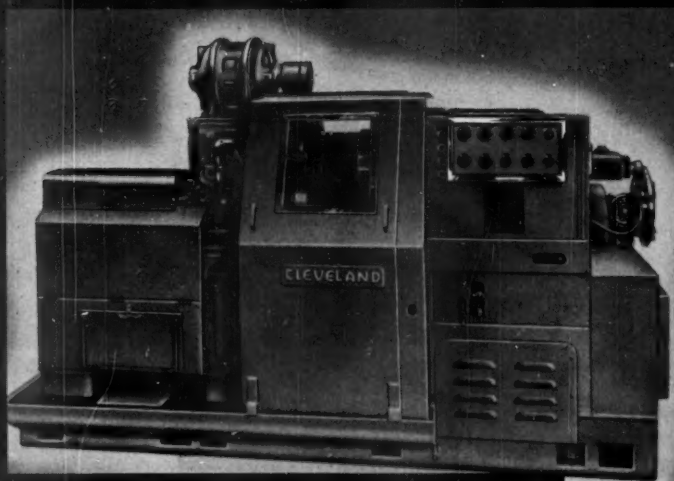
Don't Miss

READER SERVICE page 133

NEW ELECTRICAL DEVELOPMENTS #1

This Versatile Performer

CANNOT RISK NEEDLESS INTERRUPTIONS



The new Diehl Cleveland is convertible . . . from bar machine to chucker. In 2 minutes! Has electrical forward and return feed control of each turret position.

DESERVES *ECONOMY Dependable Protection*

The more useful a machine is, the more essential it is that it be protected against unnecessary blows and costly stoppages.

ECONOMY RENEWABLE FUSES with ECONOMY "De-Lay" RENEWAL LINKS offer this superior protection where time delay is needed most—namely, the 135% to 200% range in which most overloads occur.

Your Electrical Wholesaler can supply you with the new ECONOMY FUSES and easily-and-quickly-renewed ECONOMY "De-Lay" LINKS.

Send for New Catalog

Reg. U. S. Pat. Off.

ECONOMY DE-LAY RENEWABLE CARTRIDGE FUSES

2592

ECONOMY FUSE & MFG. CO., 2717 GREENVIEW AVE., CHICAGO 14, ILL. REPRESENTATIVES IN ALL PRINCIPAL CITIES

BRONCO 60
Certified
Cords and Cables
with the
60% Neoprene Jacket
WESTERN
NEOPRENE CERTIFIED 2 COND
Positive 3 Way Protection
• a jacket that contains 60% by weight of new Neoprene
• certification of the Neoprene content by a registered, professional engineer
• cords and cables that are branded "Certified"
Only with Bronco 60 *Certified* can you be sure of longer life, greater safety, more economical performance . . . cords and cables that are more resistant to oils, chemicals, acids, cutting and abrasions. Insist on the protection Bronco 60 *Certified* offers you .
WESTERN INSULATED WIRE CO.
2425 EAST 30TH ST. • LOS ANGELES 58, CALIFORNIA

A COMPLETE LINE OF
AUSTIN
OUTLET BOXES, CABLE BOXES, EXTENSION RINGS AND COVERS
Made in standard depths and combinations for use with heavy or thin wall conduit, armored cable, non-metallic sheathed cable, flexible steel conduit or flexible non-metallic tubing (loom). Also a complete line of covers for each type and size of box.
AUSTIN No. 300-½
4" Square Outlet Box
AUSTIN No. 9-O-½
4" Octagonal Outlet Box
AUSTIN No. 2-D-½
4-11/16" Square Outlet Box
AUSTIN No. 9NX
4" Cable Box
WRITE FOR INFORMATION AND PRICES ON ENTIRE BOX LINE
SOLD ONLY THROUGH WHOLESALERS
The M. E. Austin Company
NORTHBROOK, ILLINOIS

CHARLES H. GODDARD, President of the Illuminating Engineering Society, congratulates A. S. Raffel, (center), Baltimore, Md., on being the only electrical contractor to serve as chairman of a Section or Chapter of the Society this year, as Fred Pyle (right) of Gill Glass and Fixture Co., chairman of the Philadelphia Section, and of the IES East-Central Regional Conference committee, looks on with interest.

N. Y. Joint Industry Board Awards Scholarships

Dean Harry J. Carman of Columbia University presented scholarships established by the Joint Industry Board of the Electrical Industry, New York, to Robert A. Weber of Brooklyn and Melvin D. Zeisler of the Bronx. Each received a five-year $4,200 scholarship to Columbia University. Both are sons of New York electrical workers and received the grants at a board luncheon at the Waldorf-Astoria on June 20.

The two winners were chosen from approximately 60 applicants, who are sons of members of Local 3 of the International Brotherhood of Electrical Workers, A.F.L. The board consists of the union local and 450 electrical contractors.

Established last year, the scholarships will enable the youths to study for three years at Columbia University starting next fall and two at the School of Engineering. The scholarships, named after A. Lincoln Bush, chairman of the board, and William A. Hogan, financial secretary of Local 3, are given by Columbia on the basis of the applicant's academic and extra-curricular record, interviews and college entrance examinations.

A. Lincoln Bush presided at the luncheon and other speakers were John R. Dunning, dean-elect of the engineering school, Mr. Hogan and Harry A. Van Arsdale, Jr.

Eight runners-up received $100 war bonds. They were Paul Burkowski, John D. Cunningham, Herbert L. Hirschberg, Fred Kretzschmar, Arnold H. Lang, George B. O'Connell, Walter Wexler and John L. Wines.

GEORGE DAUB, *Architect*

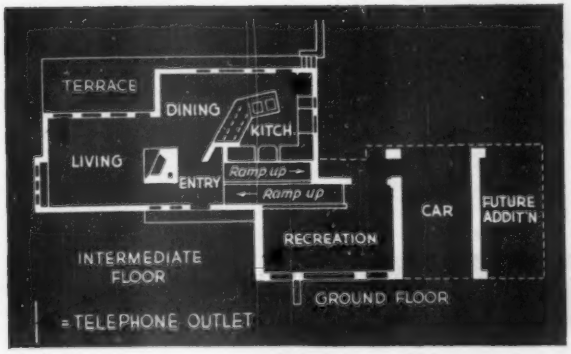
A "HIDDEN FEATURE" OF MODERN HOMES—TELEPHONE RACEWAYS

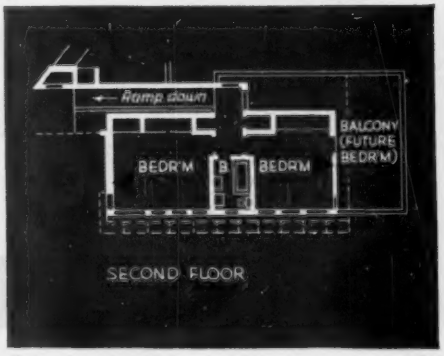
Most modern homes owe their beauty to clean simplicity of design—inside and out. Such beauty is always enhanced when telephone wires are concealed within the walls.

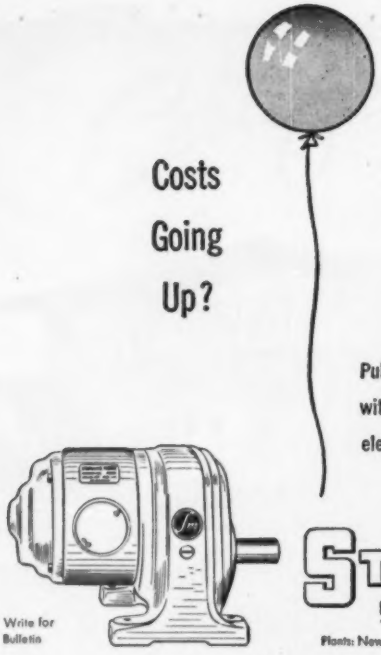
Telephone conduit, built in during construction, makes concealed wiring easy—means extra profits for you. One or two lengths of pipe or tubing placed in the walls are usually enough for the average home.

Remember—NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT INCLUDES RACEWAYS FOR TELEPHONE WIRES.

BELL TELEPHONE SYSTEM







SLO-SPEED (Geared) • SPEED-TROL (Variable Speed) • KLOSD (Normal Speed)

magno-tronic

DUAL SILVER POINT — FULLY AUTOMATIC

FLUORESCENT STARTERS

—completely eliminate annoying blinking and flickering of dead fluorescent lamps!

GUARANTEED — FOR ONE YEAR!

PROTECTS — Automatic thermal relay cuts out defective lamps, eliminates annoying blinking and protects all auxiliary equipment.

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REDUCES COST — Magno-Tronic starters provide exact timing of electrode heating, preventing excessive loss of emission material, thus assuring maximum possible lamp life.

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IBEW Supports Private Utilities

President Dan Tracy and the executive council of the International Brotherhood of Electrical Workers have thrown the weight of their union into the public-private utility battle. In public statements they have announced IBEW would combat "the increase in the area of government and quasi-government ownership" of electric utilities.

The statement of the executive council pointed out that IBEW always had supported federal development of hydroelectric power "as a by-product of soil conservation and irrigation." But, it added, the government power program that now has developed from such activities "could well be, and assumes all the aspects of, the first step in the evolution of governmental ownership of the generation, transmission and sale of electricity to the individual consumers."

IBEW opposes such a program, the council asserted, "in the interest of organized labor in the electric light and power industry." Claiming to represent 75 percent of the employees in the industry, IBEW charged that increasing government ownership of utilities "carries with it a decrease in the area of freedom for labor as well as other groups."

IBEW has had "drastic experience" as a result of the transfer of utilities from private to public or quasi-public ownership, it said. For example, in a recent case the union was "deprived of collective bargaining rights . . . even though a majority of voters of the municipality had enacted an ordinance requiring their officials to bargain with the union."

Tracy also cited the union's experience in Nebraska, where IBEW had five locals before the majority of the private utility systems were taken over by public bodies. Today, he said, the union has only one local in the State.

Tracy said he had no objection to activities of the Rural Electrification Administration to supply electric power to rural people who otherwise could not obtain it. Nor does IBEW oppose federal construction of dams to harness the nation's water power and for other purposes. But, he added, the union has objected to the transformation of these programs into a means of competing with the private utilities which employ IBEW members.

He referred to the activities of IBEW employees of the South Carolina Electric & Gas Co., wherein the company and its union employees charged that the proposed new lines would duplicate those of the company.

COVERING ALL ANGLES at recent electrical industry conference in St. Paul, Minn., are Edwin Muir (left), owner, Muir Electric Co., Jackson, Minn.; his electrician Willard Pierce and appliance sales manager (right) Dale Smith.

Outdoor Recreation Program Launched

A nationwide program to stimulate large-scale outdoor recreation on a community level was launched in New York recently by the General Electric Company, representatives of the National Recreation Association and other state and local recreation officials. This new program, which dramatizes the urgent need for year-round, day-and-night recreation for people of all ages, is the latest of the "More Power to America" series being sponsored by the General Electric Company.

Meeting in New York at the Hotel Waldorf-Astoria, representatives of recreation, welfare and civic groups were addressed by Joseph Prendergast, executive director of the National Recreation Association; Robert T. Lansdale, state (New York) social welfare commissioner and chairman of the State Youth Commission; Mrs. Helena G. Hoyt, director of recreation for Syracuse, N. Y.; and R. J. Swackhamer of the General Electric Co.

Prendergast, comparing regimented recreation in totalitarian countries to that in America, said:

"The very essence of American recreation is the right of all people to have the opportunity throughout the year for all kinds of recreation activities of their own choosing, and their own sakes."

"It is important that we know what is going on on America's playgrounds today because, just as Wellington believed that Waterloo was won on the playing fields of Eton, so I believe that the second World War was won, and the present 'cold war' which has been forced upon us will be won, on the playgrounds of America."

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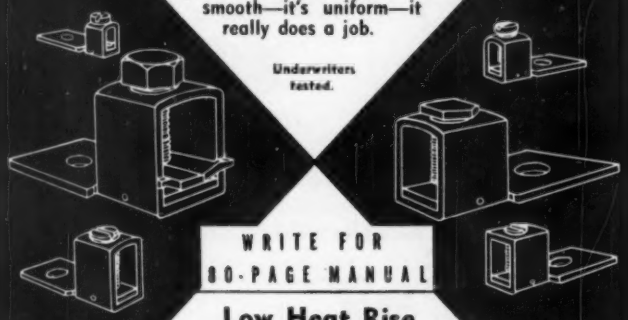

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"The spontaneous cooperation of a free people", Prendergast observed, "has its source on the playground".

Lansdale pointed to the wide acceptance of planned recreation during the five-year life of the State Youth Commission. During this time, he said, 716 New York municipalities have initiated a public recreation service for youth, or have enlarged previous services.

Project sponsors include 90 percent of the state's 62 cities, 60 percent of the 549 incorporated villages, 34 percent of the 932 towns and 20 percent of the 57 counties. Lansdale termed this "a truly remarkable and unprecedented advancement in organized recreation".

Speaking at the community level, Mrs. Hoyt described such benefits of good recreation facilities as reduced juvenile delinquency, improved mental and physical health for adults, and fewer traffic accidents involving children playing on streets.

Swackhamer said General Electric's purpose in adding outdoor recreation to its More Power to America series was to stimulate public recognition of the need for adequate day and night facilities for all age groups in all seasons and to encourage public-spirited organizations and individuals to campaign actively for planned recreation areas.

"We are interested in better communities, for they produce better citizens—who become productive workers and better customers", he said. "There is no doubt in my mind that we shall sell some equipment as a result of this program; on the other hand, recovery of the costs involved will take a long time.".

Swackhamer outlined the Outdoor Recreation program in detail, pointing out that a sound motion picture, "A

COMMERCIAL LIGHTING unit catches eyes of (L to R) contractor E. L. Peterson, St. James, Minn.; Bob Hamilton, A. L. Smith Iron Co. representative in Minneapolis; and contractor Orville Peterson of Truman, Minn., at St. Paul electrical trade show.

IMPROMPTU DIRECTOR'S huddle is held at recent electrical industry convention in St. Paul, Minn., by Sam Newstone (left), Montevideo (Midwest Electrical Council); and Norman J. DeYoung (Minnesota Electrical Association), of Fairmount, Minnesota.

Chance to Play", and quantities of booklets designed to aid community and industrial leaders in planning for better recreation, are available. A premiere showing of the 20-minute, black-and-white film, which was produced for General Electric by The March of Time, under the technical supervision of the National Recreation Association, concluded the meeting.

Affeldt Heads Wisconsin Inspectors

At the annual meeting of the Wisconsin Chapter, International Association of Electrical Inspectors at the Hotel Conway, Appleton, H. G. Affeldt, La Crosse, was elected chairman of the group. Other officers chosen at the convention included: vice-chairman, G. E. Kruecke, Milwaukee; secretary-treasurer, John E. Wise, Madison. Members of the Executive Committee are: P. A. Lundholm, Madison; George Garland, Marinette; A. G. Addler, West Allis; and E. W. Klitzke, Oshkosh.

The 9 registrants at the conference engaged in lively discussions covering inspection in rural areas; television antennae installations; explosion-proof wiring, closed-circuit fire alarm systems; and the question of making all branch circuits 20-ampere capacity.

The Chapter went on record as favoring state legislation to authorize counties to regulate electrical construction work and set up inspection departments within their respective jurisdictions. At present, cities, villages and townships have the authority, but in-

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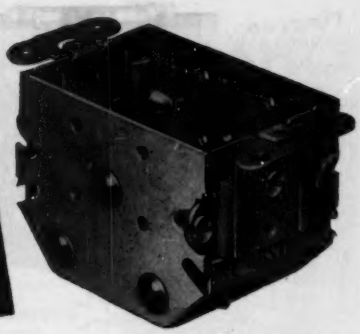

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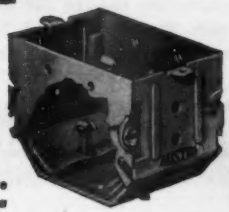

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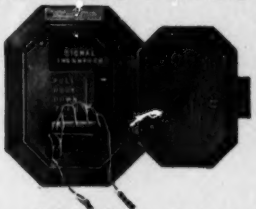
Systems fully supervised including coding contacts which give immediate notification of trouble that may occur on circuits.



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between rural areas are without coverage. Provisions were also made for the appointment of a committee to study television antennae installation problems. In several cases, improperly supported antennae have fallen, some dropping across high voltage lines and causing outages. The committee will be charged to thoroughly investigate this field and make the necessary recommendations for safe installations.

Simpson Heads Chicago Electric Assn.

Clif Simpson was recently named managing-director of the Electric Association of Chicago. He succeeds Major Ainsley A. Gray who is retiring after 20 years active leadership of the group.

Prior to his appointment to head the Electric Association, Mr. Simpson was managing-director of the National Appliance and Radio Dealers Association in Chicago.

Book Reviews

IES Lighting Study Project Reports

The Illuminating Engineering Society has recently announced three new reports covering Lighting Study Projects in Industry. One is on "Lighting for Woolen and Worsted Textile Mills", another is on "Lighting for Machining of Small Metal Parts", and one on "Lighting for Canneries".

These reports summarize the studies and conclusions of technical commit-

NORTH DAKOTA CONTRACTOR and president of NDECA, Chester A. Brown (left), Electric Sales and Service, Dickinson, brought his foreman Roy Dowell to the recent electrical industry convention at St. Paul, Minnesota.

MAINTENANCE ELECTRICIANS J. R. House, Plymouth Div., Chrysler Corp., Detroit; and H. B. Holmes (right), Missouri Pacific Railroad, Dupo, Ill., get together at recent St. Louis meeting of the Industrial Section, St. Louis Electrical Board of Trade.

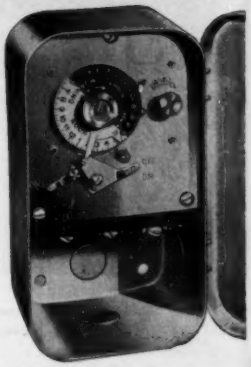
tees of the Society over a period of years, and contain the latest available information about many aspects of the art and science of illumination. They include details of application as well as lighting technique.

Comprising 12 pages and cover, "Lighting for Woolen and Worsted Textile Mills" describes and illustrates the various operations in textile mills from wool sorting through to the finished cloth. Recommended levels of illumination are given for each operation, correlated with considerations of flexibility, installation, maintenance and production records. This report was prepared by a joint IES-ASME Committee on Lighting in the Textile Industry. In this study 17 New England woolen and worsted mills participated, serving as laboratories for committee representatives.

"Lighting for Canneries" is a completely illustrated 36-page booklet describing the recommended lighting conditions through all operations of the canning processes. It was prepared by the IES Sub-Committee on Lighting in the Canning Industry of the Committee on Lighting Study Projects in Industry. Because of the wide variety of seeing tasks involving many different colors, the development of sound recommendations necessitated research beyond normal committee facilities. Thus, the National Canners' Association cooperated by sponsoring a Cannery Lighting Research Fellowship at Stanford University for a period of three years. This lighting study report is the result of this close cooperation between the canners' own organization and the IES committee.

In addition to recommendations for

NEW... THE RELIANCE "Model 400"



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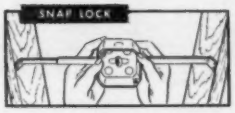

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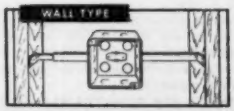
The wall type hanger is used for #1900—4" square boxes when they are used as switch boxes. No stud to interfere with switch.



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- *Fits any ½" Drill*
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The Lindell Drill Attachment, Model #30, permits easy boring in tight, hard-to-reach places . . . bores holes straight through joists or studdings. Fits all ½" electric hand drills. Adjustable handle. Four foot all metal shaft allows boring overhead or below without adjusting. Boring head contains gears which reduce speed to two-thirds that of your drill. Conserve your time and labor with the low cost Lindell Drill Attachment.

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lighting actual processing areas, the study describes illumination for offices and laboratories and constitutes a complete lighting guide for anyone concerned with illumination for canneries.

"Lighting for Machining of Small Metal Parts" was prepared by the IES committee of the same title. Because of the wide variety of seeing tasks encountered in the metalworking field, this new 16-page report presents illumination recommendations for some of the major and most exacting lighting problems. Fully illustrated, it recommends lighting for operations from general and supplementary lighting through lighting for specific tasks. Special attention is given to measuring instruments and rules, and to graduated feed indicating scales. It also prescribes illumination for bench work and inspection, in addition to lighting for precision type lathes, internal and external grinders, shapers and drill presses.

These new IES reports will be of vital interest to those concerned with proper lighting and seeing conditions in each of these three industrial fields, including electrical contractors, maintenance engineers, electrical engineers and others. They are available from the Publications Office, Illuminating Engineering Society, 51 Madison Avenue, New York 10, N. Y. Price: 50 cents per copy.

Transformers

"Transformer Principles and Practice", by J. B. Gibbs, design engineer for the Westinghouse Electric Corporation, is a non-mathematical discussion description of transformers and the principles underlying their operation. Mathematical work is limited to a few simple examples to illustrate the use

RURAL WIRING techniques comprise discussion of Minnesota contractors Wallace Wedel (left), Albany; and S. J. Muggi of Cold Spring, Minnesota.

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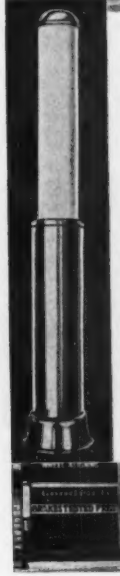

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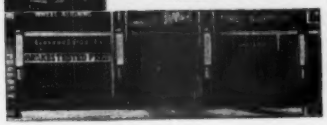

of formulas included in the main text although, for those who wish to follow this approach deeper, a chapter is included to solve more complex transformer problems.

Subjects included are single phase and 3-phase transformers, coils and cores, cooling methods, temperature indicators, ratio adjustment, transformer oil vs askarel, maintenance of oil quality, mechanical forces in transformers, insulation and lightning protection, transformer polarity, usual connection diagrams, parallel operation of units, special applications, phase transformation, constant-current regulation, current-limiting reactors, testing and care of transformers.

Over 200 illustrations, both diagrammatic and pictorial, a complete index and numerous charts and tables add to the clarity of the text. The book, published by the McGraw-Hill Book Company, Inc., measures 6 by 9 inches, includes 236 pages, is covered in stiff blue fabricoid with a red and blue title block, and is priced at $3.50.

Power Switchgear

The revised edition of NEMA Standards for Power Switchgear Assemblies covers the rating, testing, manufacturing and application of assemblies of switchgear devices such as switches, interrupting devices and control, metering, protective and regulating equipment with associated interconnections and supporting structures. Information concerning standard equipment, abbreviations, device numbers and symbols, and instructions for the installation, operation and care of power switchboards is also included.

The book, covering 64 pages, is priced at $4.00 and is published by the National Electrical Manufacturers Association, 155 E 44th St., New York 17, N. Y.

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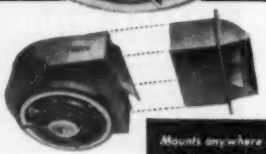

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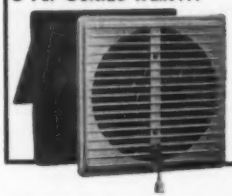

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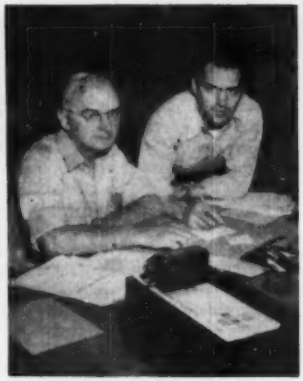

FATHER AND SON combination operate the Phoenix Electric Company, motor service shop in Mansfield, Ohio. C. A. Bonham (left) has been in the electric motor repair business for some 18 years, while his son R. A. Bonham (right) has been with his dad for 10 years—with time out for college and service in the U. S. Navy during the War.

Machine Tools

The first of two volumes on manufacturing processes evolved from courses developed at Rennselaer Polytechnic Institute, "Machine Tools for Engineers", is just off the press. The second volume, on casting and forming, is still in preparation and will be published in the near future.

"Machine Tools for Engineers" introduces the student to the fundamentals of machine tools and production processes. All types of machine tools are described and analysed. Their purpose, limitations, possibilities and use are explained.

Written by Charles R. Hine, E.E., assistant professor of Manufacturing Processes at R. P. I., the book discusses cutting tools, measurement, the lathe, threads and threading, the drill press and hole making, shapers, planers, broaching, grinding and abrasives, gear making, jig boring, sawing and microfinishes. Photographs, diagrams, an appendix and index complete the presentation. The book includes 355 pages measuring 6 by 9 inches, is bound in green fabricoid and is priced at $3.50. It is published by the McGraw-Hill Book Company, Inc. 330 W. 42nd St., New York 18, N. Y.

Oil Burners

Complete information on fuel oil, oil burning and oil burners is included in the revised second edition of "Oil Burners" written by Kalman Steiner, consulting engineer and author of numerious books and articles on this general subject. The book described in detail what the designer, installer, service man and user needs to know about design, production, installation, operation and maintenance of domestic, industrial and commercial oil burners.

Both theory and practice are covered, and related material such as electronic controls, refractories, capacities of boilers and warm air furnaces, draft and combustion control, temperature regulation and fluid flow are included. For the man who wants a wealth of on-the-spot information available for ready reference, this book fills a definite need. Charts, tables, diagrams, sketches and photographs clarify the text. Covering 502 pages measuring 6 by 9 inches, this green-bound volume is priced at $6.50 and is published by the McGraw-Hill Book Company, 330 W. 42nd St., New York 18, N. Y.

Magnetic Controls

A clear, comprehensive picture of the characteristics of control devices, the function of commonly used control circuits, and what performance can be expected of various types of motors is available in "Magnetic Control of Industrial Motors" by Gerhart W. Heumann, control engineer for the General Electric Company. The book stresses the considerations governing the selection of controllers to perform specific jobs and covers discussions of complete controllers of various frequently-used designs, external motor characteristics, rating and selection of con-

IOWA ELECTRICAL ASSOCIATION officers are: (L to R) secretary—George Siefken, Siefken Electric Co., Spirit Lake; vice-president — John Tallman, Tallman Wood and Electric Co., Clarion; president—C. E. Nelson, Nelson Electric Co., Ames, Iowa.

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EXCHANGING IDEAS on plant electrical maintenance techniques are: (L to R) H. F. Schwarting, general electrical engineer, American Car & Foundry Co., St. Louis, Mo.; R. J. Benson, plant engineer Wagner Electric Corp., St. Louis; and Patrick P. Hackett, chief electrician, American Steel Foundries, Granite City, Illinois.

trol devices, basic magnetic devices such as contactors and relays for direct and alternating-current, manual versus magnetic control, basic amplidyne control circuits, electronic devices, maintenance of equipment and fundamentals of motor performance and circuit layout.

Measuring 6 by 9 inches, the book includes 589 pages, 365 illustrations and a complete index. The book is priced at $7.50 ($9.75 from Canadian agents) and is published by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y.

Safety Directory

"Best's Safety Directory for 1950-1951" covers the entire field of fire protection and control, hygiene, first aid, sanitation and safety. It is unique in the fact that it combines the best practical features of a safety manual, directory index, encyclopedia and catalog in one profusely-illustrated volume. What devices and products are available are suggested for specific hazards, and where to get them and how to use them are also listed.

Through cross-indexing and subject-grouping, it is easy to locate safety products even when the user is not certain of the type or name of product he requires. The arrangement also serves as a check-list of hazards, many of which are frequently overlooked. The sections are divided into classifications such as Arm and Hand, Body and Leg, Eye and Face, Fire, etc.

Priced at $5.00 with lower rates quoted for quantity purchase, the Directory is published by Alfred M. Best Company, 75 Fulton Street, New York 7, N. Y.

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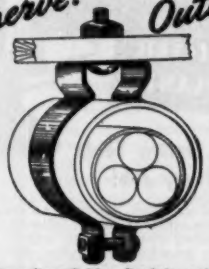

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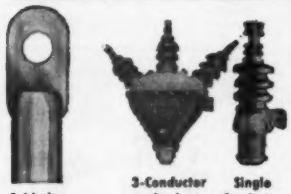

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Dates Ahead

New York State Association of Electrical Contractors & Dealers, Inc.—Saranac Inn, Saranac Lake, N. Y., July 1-8.

Illuminating Engineering Society—National Technical Conference, Hotel Huntington, Pasadena, Calif., Aug. 21-24.

International Association of Electrical Inspectors—Northwestern Section, Seattle, Wash., Sept. 11-13; Southwestern Section, San Jose, Calif., Sept. 18-20; Eastern Section, Hotel Statler, Buffalo, N. Y., Sept. 25-27; Western Section, Hotel Book Cadillac, Detroit, Mich., Oct. 2-4; and Southern Section, Daytona Beach, Fla., Oct. 16-18.

International Municipal Signal Assn.—55th Annual convention, Hotel Commodore, New York, N. Y., Sept. 18-21.

Canadian Electrical Manufacturers Assn.—Annual meeting, General Brock Hotel, Niagara Falls, Ont., Sept. 27-29.

International Association of Electrical Leagues—Annual Conference, Copley Plaza Hotel, Boston, Mass., Oct. 11-14.

National Electrical Contractors Association—Annual convention, Hotel Biltmore, Los Angeles, Calif., Oct. 17-20.

National Electrical Manufacturers Association—Chalfonte-Haddon Hall, Atlantic City, N. J., Nov. 13-16.

American Standards Association—Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y., Nov. 27-29.

American Institute of Electrical Engineers—Winter General Meeting, New York, N. Y., Jan. 22-26, 1951.

Illuminating Engineering Society—New York Section, Northeastern Regional Conference, Hotel Statler, New York, N. Y., October 26-27.

National Electric Sign Association—Hotel New Yorker, New York, N. Y., February 5-7.

Manufacturers News

Paul M. Deal has been appointed administrative assistant of **General Electric Company's** fractional horsepower motor divisions.

C. E. Burke has been named manager of sales of G.E.'s specialty transformer and ballast divisions.

Gordon C. Harvey has been named division engineer of G.E.'s ballast, engineering division.

C. C. Clymer has been appointed manager, materials handling and testing equipment division of G.E.'s industrial engineering divisions. Mr. Clymer is replacing M. A. deFerranti, who has been appointed assistant to A. W. Jacobsen, manager, parts division, aircraft gas turbine divisions.

The establishment of a new sales division in the marketing organization of G.E.'s air conditioning department has been announced. Formation of the division completes the consolidation of automatic heating equipment and cooling equipment responsibilities which have been under way for the past several months.

The new division will be responsible for the sale and servicing of automatic heating equipment, air conditioning equipment, refrigeration machines, commercial refrigeration, and water coolers. Its activities will include direct sales to large contractors, industrial and other direct accounts, distribution sales at wholesale and retail, and parts sales and product service.

H. M. Brundage, manager of the

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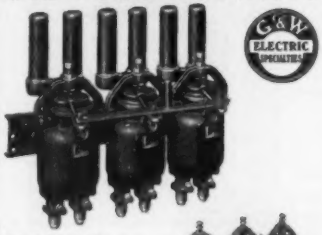
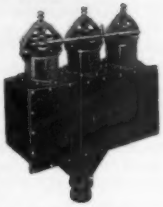


SUBWAY, VAULT AND OVERHEAD.



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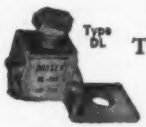

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SINCE 1904

former automatic heating division, which was absorbed in the reorganization, has been appointed manager of the new division.

Harry J. Wines, formerly manager of automatic heating sales, has been named manager of distribution sales. The responsibilities of J. D. Hoffman, manager of direct sales, and L. E. Thompson, manager of parts sales and product service, have been extended to include heating equipment as well as cooling equipment lines.

•

National Electric Products Corp., Pittsburgh, has purchased I. A. Bennett & Co., Chicago, for 46 years an exclusive sales agent in 15 midwestern states for the National line of electrical roughing-in materials. The Bennett offices, warehouses and personnel are functioning as a part of the National Electric factory branch organization.

R. C. Bennett, Jr., former general manager of the Bennett firm is now vice president and sales manager of National Electric. Earl M. Nelson, sales manager for Bennett has become National Electric Midwest district manager. He will supervise factory branch sales offices in Chicago, St. Paul, St. Louis, Kansas City, Dallas, Houston and Des Moines.

•

The American Coach & Body Company, Cleveland, Ohio, has announced the following sales changes. Two new district sales offices have been opened in Chicago, Ill., and Tulsa, Okla. The former is in charge of Ruben Bauer, sales manager for the Midwest division and the latter is headed by Homer Feyen, sales manager of Southwestern division.

Other promotions announced include: Arthur Frank, who is now sales manager of Central division, with headquarters in Cleveland; Robert Rector, sales manager Southern division, headquarters in Atlanta; T. A. Pelsue, sales manager Western division, headquarters in Denver; William Higgs, assistant sales manager with headquarters in Cleveland, Ohio.

•

Tom Turner, who joined the **Westinghouse Electric Corporation** in 1922 as a machinist at the East Pittsburgh Works, has been elected a vice president. He will have charge of plant labor relations with headquarters in Pittsburgh.

Vice president W. O. Lippman, formerly in charge of plant labor relations, becomes head of the Westinghouse Elevator Division at Jersey City, N. J.

Herbert H. Rogge recently was elected president and chief executive officer of the Canadian Westinghouse Company Limited. At the same time,

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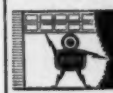

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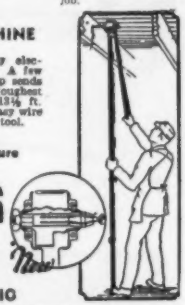

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STATION A

ALLIANCE, OHIO

the board of directors of the Canadian company elected Harold A. Cooch, former president, chairman of the board to succeed John R. Read, who is retiring after 50 years of service.

•

The Southern portion of the sales territory served by the St. Louis electrical division branch of **Wagner Electric Corporation** has been set up as a separate unit, with headquarters in Memphis and a sales office in New Orleans. A. C. Allen will remain at Memphis as branch manager of the newly established territory.

The remaining territory, with a main branch in St. Louis and a sub-branch in Indianapolis, will be under the direction of J. J. Scheid, who succeeds H. N. Felton as manager of the St. Louis Branch. Mr. Felton was recently elected vice president in charge of sales of the Wagner Company.

•

Simplex Wire and Cable Company has announced the following personnel changes: G. L. Roberts has been elected vice president and will remain in charge of the sales activities of the company; G. A. Grauer has been appointed sales manager, succeeding Mr. Roberts; E. W. Davis has been named director of engineering; G. J. Crowdes has been named chief engineer; and E. J. MacKenzie has been appointed advertising manager.

•

General Lighting Company, New York, has named Edward Allman, Harristown, Pa., as new representative for the metropolitan Philadelphia area. Carl H. Krause, Rockford, Mich., was named for the state of Michigan and Len Forman, Rocky River, Ohio, will cover Nebraska, Missouri and Kansas.

•

Announcement has been made of the appointment of John V. Flynn as central New York district apparatus & supply sales manager for the **Westinghouse Electric Supply Company** with headquarters at Rochester, N. Y.

•

The Electric Products Company, Cleveland, Ohio, has named the following representatives: Vincent J. Brown Company, Buffalo and Syracuse, for New York State with the exception of metropolitan New York City; Klass Company,. Minneapolis, in the states of Minnesota, North and South Dakota and the western counties of Wisconsin; and Muth-Richards Company, Seattle, Wash., in the state of Washington and the panhandle of Idaho.

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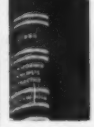
Transformer Principles and Practice



3. Revised up-to-date book dealing with the construction and use of transformers, including underlying principles, applications, connection, testing, care and economics. Gives pointers on polarity, ratio adjustment, transformer oil, mechanical forces, etc. Includes material on current-limiting reactors and new construction. By J. B. Gibbs, Westinghouse Elect. Co., 232 pages, $3.50

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At a recent meeting of the board of directors of **Sylvania Electric Products Inc.**, following the annual meeting, Max F. Balcom was elected chairman of the board to succeed the late Walter E. Poor, and Frank A. Poor, founder of the company, was elected vice chairman.

Three new directors were elected: Edward J. Poor, who resigned as chairman in 1943, Richard L. Bowditch, president of C. H. Sprague & Son Company, and H. Ward Zimmer, vice president in charge of operations.

Sylvania Electric has moved its New York offices to new headquarters at 1740 Broadway.

•

Gedney Electric Company, New York, has announced the appointment of Herbert H. Benfield as vice president in charge of sales. Mr. Benfield was formerly manager of conduit sales for Steel and Tubes Division of Republic Steel and for the past seven years has been Eastern Division manager of Bull Dog Electric Products Company.

•

The Century Electric Co. has announced that Edwin S. Pillsbury, one of the founders and president since 1914, relinquished his presidential post to be succeeded by his son, **Fred H.** Pillsbury. The elder Pillsbury will continue as chairman of the board of directors, with his son taking over active management of the company. Fred H. Pillsbury has been vice president in charge of operations since last July and a member of the Board of Directors since 1942.

•

The Electric Equipment Company, Rochester, N. Y., has purchased a million dollar government built plant from the General Services Administration. The purpose of the purchase is to consolidate the company's activities, which at present, include warehouses in Rochester, Buffalo, Watertown, Canton, Ohio, and Houston, Texas.

•

Burndy Engineering Company, New York City, has named Jim Hennessy as supervisor of distributor sales.

•

Allied Control Company, Inc., has announced the appointment of O. I. Price of Magnetic Devices, Inc., Frederick, Md., to handle sales of electrical relays in the state of Maryland, District of Columbia and Virginia.

•

Announcement has been made of the appointment of George Kielty as district manager of the **Mitchell Manufacturing Company** in the Pittsburgh area.

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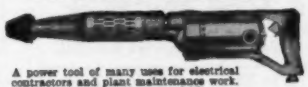

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Ask for BULLETIN 485-EC

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4627 W. Huron St. Chicago 44, Ill.

When you're in need of some product or service to speed and improve operation, or save money, you may find it here—in the Where To Buy Section. It pays to check this page . . . *each issue.*

NEW ROLL FUSE PULLER

patent pending

Will roll out the most stubborn fuse-cartridge type up to 100 Amp 250 volt, Up to 60 Amp 600 volt 1", ¾", ½" dia. 1/5 of ordinary effort req'd. Handy Electricians' Tool 7" overall Black fibre—tried and tested.

$1.25 ea. post paid USA

dealers invited—discount in lots. Money refunded if not satisfied. Send for yours today to

R. I. ELECT APPLIANCE CO.

P. O. Box 253, Woonsocket, R. I.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

90c a line, minimum 4 lines. To figure advance payment count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS, 90 cents an insertion.

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The advertising rate is $9.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅛ inch vertically on one column, 3 columns — 30 inches — to a page. E.C.&M.

NEW ADVERTISEMENTS received by 10 A.M., July 14, will appear in the issue of August, subject to limitation of space available

---

WANTED

TRAFFIC SIGNAL SALES ENGINEER

Must have experience in Design & Installation of Traffic Lights and Controls.

P-6905, Electrical Constr. & Maint.
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

FOR SALE

Pipe Bending Computer:
One turn of disk gives you all information to bend any radius from 10 to 57 inches. Use with hydraulic bender with two supports and moving plunger between them. Computer enclosed in pocket sized envelope, with instructions. $1.25 postpaid or $12.50 per doz. Write Computers, Box 193, Dept. S, Cedar Grove Station, Shreveport, La.

WANTED

ANYTHING within reason that is wanted in the field served by Electrical Construction & Maintenance can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

REPUTABLE MANUFACTURERS AGENTS

Operating in the Metropolitan territory—maintain N. Y. warehouse stock, seeks one additional line. Highest references.

RA-7010, Electrical Constr. & Maint.
330 W. 42nd St., New York 18, N. Y.

WANTED—DIRECT SALE LINES

Equipment — Tools — Test Gear
covering
Ore. - Wash. - Idaho - Western Montana
JAMES L. KEARNS, E.E.
P. O. Box 5108 Portland, 16, Ore.

GENERATOR SET

Used Fairbanks-Morse 5 cylinder, 176 horsepower @ 720 RPM, with 125KVA Electric Machinery Generator—220-440 volt, 3 phase, 60-cycle. Skid mounted. Only 500 hours. $10,000.00.

MICHIGAN TRACTOR & MACHINERY CO.
13801 Lyndon Ave. Detroit 27, Mich.
Phone: VErmont 7-5000

FOR SALE!
2 Carloads Of
USED ELECTRICAL MOTORS
And Pumps

Recovered from dismantling of two major chemical process jobs
From 2 H. P. to 200 H. P.

Will Sacrifice At **$3.00** Per H. P.

Write For Complete Inventory

BROWN-STRAUSS CORPORATION
Dept. E Phone LD 169
P.O. Box 78 Kansas City, Mo.

SURPLUS CABLE SALE

- Army specs. W143—2 conductor #14 parallel pair 7 copper strands ea. 0216 dia. insulated.
- 44 conductor copper Okonite "Armertite"—burial without costly conduit.
- Field telephone wire W110B. 3 copper, 4 steel strands.
- Perfect condition — large quantities

JEFF LEE PRODUCTS
1919 Derry St., Harrisburg, Penna., Phone 67961

Special Offering!

2000 NEW
air cooled
—TRANSFORMERS—

- **WILL OPERATE ON 220 AND 440 CIRCUITS**

All transformers insulated with fiber glass; no fireproof vaults required. For lighting and power.

★ **LOW PRICES** ★

KVA	VOLTAGE RATING
¾ to 25	450 to 117
7½ to 25	225/450 to 117/234
PHASE CHANGERS	
15 to 50	220 or 440 to 220

MANUFACTURED BY ALLIS CHALMERS

- *Crated for immediate delivery*

AMERICAN ELECTRIC SERVICE & MAINTENANCE CO.
SPRINGFIELD, MASS.
MOTORS • GENERATORS • TRANSFORMERS • SALES • REPAIRS • RENTALS

BOOKS

ELECTRICAL CONTRACTORS ESTIMATING HANDBOOK
"A Unique Tool of the Trade"
WRITE FOR DESCRIPTIVE FOLIO TO
THE ESTIMATOR PUBLISHING CO.
1805-B 60th St. Kenosha, Wis.

WANTED

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES
No lengths too long or too short
Telephone: Eastgate 7-4778
PIERCE CABLE CO.
2664 Clybourn Ave., Chicago 14, Illinois

SEARCHLIGHT SECTION

(Continued from opposite page)

RUBBER TAPE

15 Ft. Rolls, ¾ in. wide, guaranteed good live rubber, Plymouth or U. S., wrapped, mostly boxed.

8¢ Per Roll — Minimum Order 50 Rolls

500 Rolls at .07½ 1000 Rolls at .07

! Pay Nothing With Order

Mail us your order. After receipt of tape, remit inside of 10 days, plus postage, or return tape at our expense, if not satisfied.

Large Lots or Long Distance Orders Shipped by Freight.

2 Samples Sent Postpaid For 35c in Stamps.

SURPLUS SALES CO.
320 Kansas Av. Topeka, Kans.

WATTHOUR METERS

POLYPHASE

3 PHASE 4 WIRE
3 PHASE 3 WIRE
3 WIRE NETWORK METERS
IN ALL RATINGS

Plus all Single Phase ratings

When inquiring specify with or without Demand Register

METERS WANTED

THE ELECTRICAL WATTHOUR METER COMPANY
76-15 Woodside Ave., Elmhurst, L. I., N. Y.
Tel.: HAvemeyer 9-0131

MOTORS, GENERATORS, TRANSFORMERS

1 — 1500 H.P.
Bought and Sold
New and Rebuilt

ELECTRIC EQUIPMENT CO.
ROCHESTER 1, N. Y.

ELECTRICAL CABLE

- for every industrial and power application.
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL Wire and Cable Co.
2686 N. Clybourn Ave. Chicago 14, Ill.

WATTHOUR METERS

Large Stock - Reconditioned - Guaranteed Single-Phase, Polyphase and DC —Write for Bulletin.

MASPENOCK ELECTRIC LIGHT CO.
44 Starr Lane Jamaica Plain, Mass.

William Deans, chief engineer of the **I-T-E Circuit Breaker Company,** Philadelphia, Pa., has been elected vice president in charge of engineering.

Gus E. Heberlein, who has been chief engineer of I-T-E's subsidiary, Railway & Industrial Engineering Company, Greensburg, Pa., has been appointed manager of the switchgear division of the parent company.

•

James P. Nolan has been appointed organization supervisor of the **Trumbull Electric Manufacturing Company,** Plainville, Conn.

Robert G. Page has been named design engineer of Trumbull.

•

The appointment of Alfred C. Lindquist as manager of sound products and associated electronic activities of **RCA Engineering Products Department** has been announced.

•

The Arrow-Hart & Hegeman Electric Co., Hartford, Conn., has announced the appointment of Russell A. Howland as Los Angeles district manager.

•

The Electro Manufacturing Corporation of Chicago, has announced the appointment of Edward Bostonian, New York City, as its district manager metropolitan New York City, northern New Jersey and Westchester County, N. Y.

•

D. W. Onan & Sons, Inc., Minneapolis, has announced the appointment of the Nelson Equipment Company, Portland, Oregon, as distributors in the state of Oregon and in several counties in Idaho.

•

The Blackburn Specialty Company, Cleveland, Ohio, has changed its name to Blaco Manufacturing Company, and products manufactured will be sold under the new trade name Blaco. There are no changes in management personnel.

•

The promotion of Fred F. Sampson, Jr., to the position of manager of electrical sales, textile products division of **Owens-Corning Fiberglas Corporation,** has been announced.

•

Gould Storage Battery Corporation, Trenton, N. J., has advanced K. A. Vaughan, manager field engineering, to the newly created position of manager sales engineering.

Sentry
(AIR-THERMAL)

FLUORESCENT STARTERS

PROTECT

YOUR LAMP LIFE
YOUR BALLASTS
YOU FROM COSTLY MAINTENANCE

THROUGH

Uninterrupted filament preheating providing consistent one-cycle starting.
Automatic cut-out of defective or deactivated lamp.
Automatic reset after cut-out conditions corrected.

For technical literature write dept C 7

INDUSTRIAL STARTER CORP.
6 Pell St. New York 13, N. Y.

FIRST CHOICE *for* All Wire Connections

Above — Sherman "Wedge - Grip" Connectors. Widely used for outlet and switch boxes, motor boxes, etc. 4 sizes, for 2 to 20 gauge wire.

Below — Sherman Split - Bolt" Connectors. Strongest made — heavy hex head, die-cut threads, solid spacers. Wide range of sizes, for all wire and cable.

Thousands of Master Electricians use these fine, precision made Sherman Solderless Connectors. They are produced from the best of copper and bronze, machined with great accuracy, and individually inspected. Every connector makes a secure joint, of highest conductivity.

Write today for free samples and catalog bulletins. No. 22-25.

H. B. SHERMAN MFG. CO.
Battle Creek Michigan

Sherman

SOLDERLESS CONNECTORS

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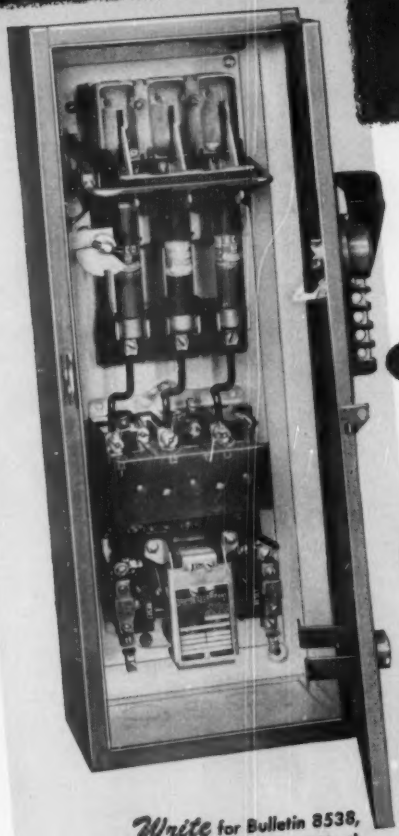


THIS NEW SQUARE D COMBINATION STARTER (SWITCH TYPE) offers Greater Operator Safety and Longer Motor Starter Life

NEW ***Switch Operating Mechanism*** provides maximum operator safety. Interlock prevents opening door when disconnect is on. When door is re-closed, self-aligning handle indicates true position of disconnect. Operating handle can be locked on or off with one, two, three or four padlocks of varying sizes. Handle-locking mechanism also locks door.

NEW ***Switch Design*** has quick make and quick break action—no dead center—visible blades for easy checking—magnetic arc plate for high rupturing capacity—dead-front line terminals, protected by hinged arc chamber cover—positive pressure jaws and fuse clips—non-tracking insulation.

NEW ***Features in Magnetic Starter Design*** Square D's time-proven design has always provided easy installation, simple maintenance, and long life. Now, even longer life is assured by straight line, guided motion of armature and movable contact assembly which eliminates bearing and reduces wear. For added convenience and flexibility, Square D starters now have NEMA standard mounting and wiring.

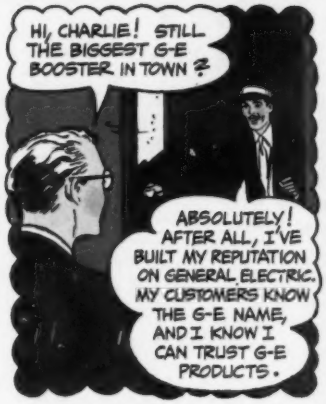
Write **for Bulletin 8538, SQUARE D COMPANY, 4041 North Richards Street, Milwaukee 12, Wis.**

SQUARE D COMPANY

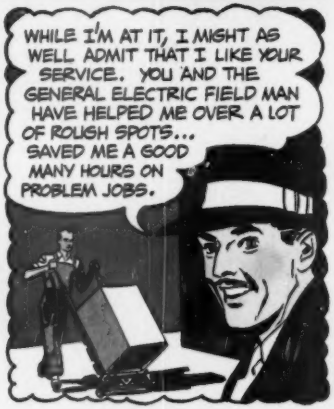
DETROIT · MILWAUKEE · LOS ANGELES

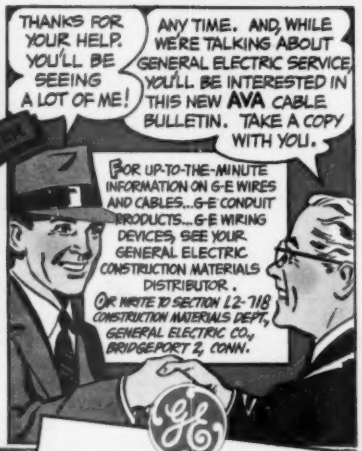
SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

ANOTHER NEW TRUCK FOR TYLER!
HOW DO THEY DO IT?
I THINK I CAN TELL YOU HOW THEY DO IT. I WAS DOWN AT THE G-E DISTRIBUTOR'S THE OTHER DAY WHEN CHARLIE TYLER WALKED IN, AND....
TYLER ELECTRIC CO.


HI, CHARLIE! STILL THE BIGGEST G-E BOOSTER IN TOWN?
ABSOLUTELY! AFTER ALL, I'VE BUILT MY REPUTATION ON GENERAL ELECTRIC. MY CUSTOMERS KNOW THE G-E NAME, AND I KNOW I CAN TRUST G-E PRODUCTS.

AND, YOU KNOW, CHARLIE, YOU'RE KEEPING YOUR INVENTORY DOWN BY HANDLING ONLY G-E PRODUCTS.
RIGHT AGAIN. I DON'T NEED TO STOCK ITEMS FROM HALF A DOZEN MANUFACTURERS. ONE LINE IS ALL I NEED.


WHILE I'M AT IT, I MIGHT AS WELL ADMIT THAT I LIKE YOUR SERVICE. YOU AND THE GENERAL ELECTRIC FIELD MAN HAVE HELPED ME OVER A LOT OF ROUGH SPOTS... SAVED ME A GOOD MANY HOURS ON PROBLEM JOBS.


THANKS FOR YOUR HELP. YOU'LL BE SEEING A LOT OF ME!
ANY TIME. AND, WHILE WE'RE TALKING ABOUT GENERAL ELECTRIC SERVICE, YOU'LL BE INTERESTED IN THIS NEW AVA CABLE BULLETIN. TAKE A COPY WITH YOU.
FOR UP-TO-THE-MINUTE INFORMATION ON G-E WIRES AND CABLES...G-E CONDUIT PRODUCTS...G-E WIRING DEVICES, SEE YOUR GENERAL ELECTRIC CONSTRUCTION MATERIALS DISTRIBUTOR. OR WRITE TO SECTION L2-718 CONSTRUCTION MATERIALS DEPT, GENERAL ELECTRIC CO., BRIDGEPORT 2, CONN.

GENERAL ELECTRIC

CONSTRUCTION MATERIALS DEPARTMENT